SOIL SURVEY OF

Harrison County, Missouri

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Missouri Agricultural Experiment Station

How To Use This Soil Survey

General Soil Map

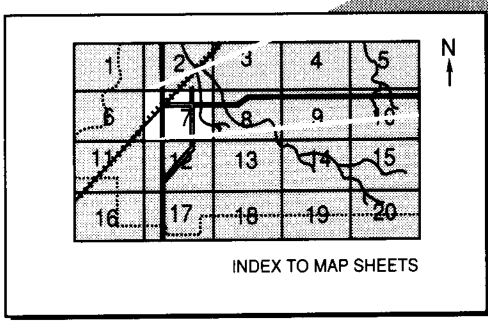
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

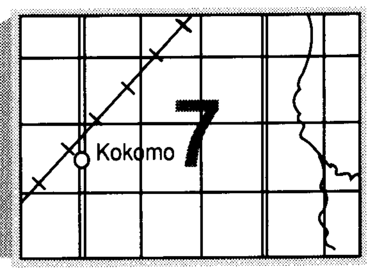
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

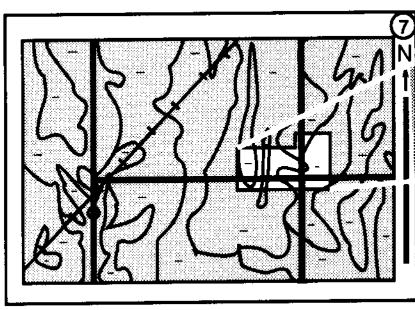


INDEX TO MAP SHEETS

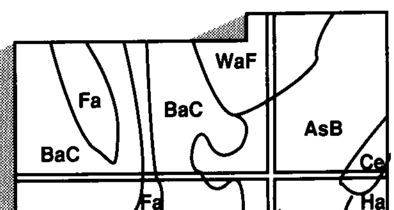


MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1972-75. Soil names and descriptions were approved in 1976. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1975. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. It is part of the technical assistance furnished to the Harrison County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Typical landscape of the Shelby-Adair-Zook map unit. The meadow and draw provide food and cover for wildlife.

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Issued March 1979

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Summary of Tables

Foreword

The Soil Survey of Harrison County, Missouri contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Kenneth G. McManus

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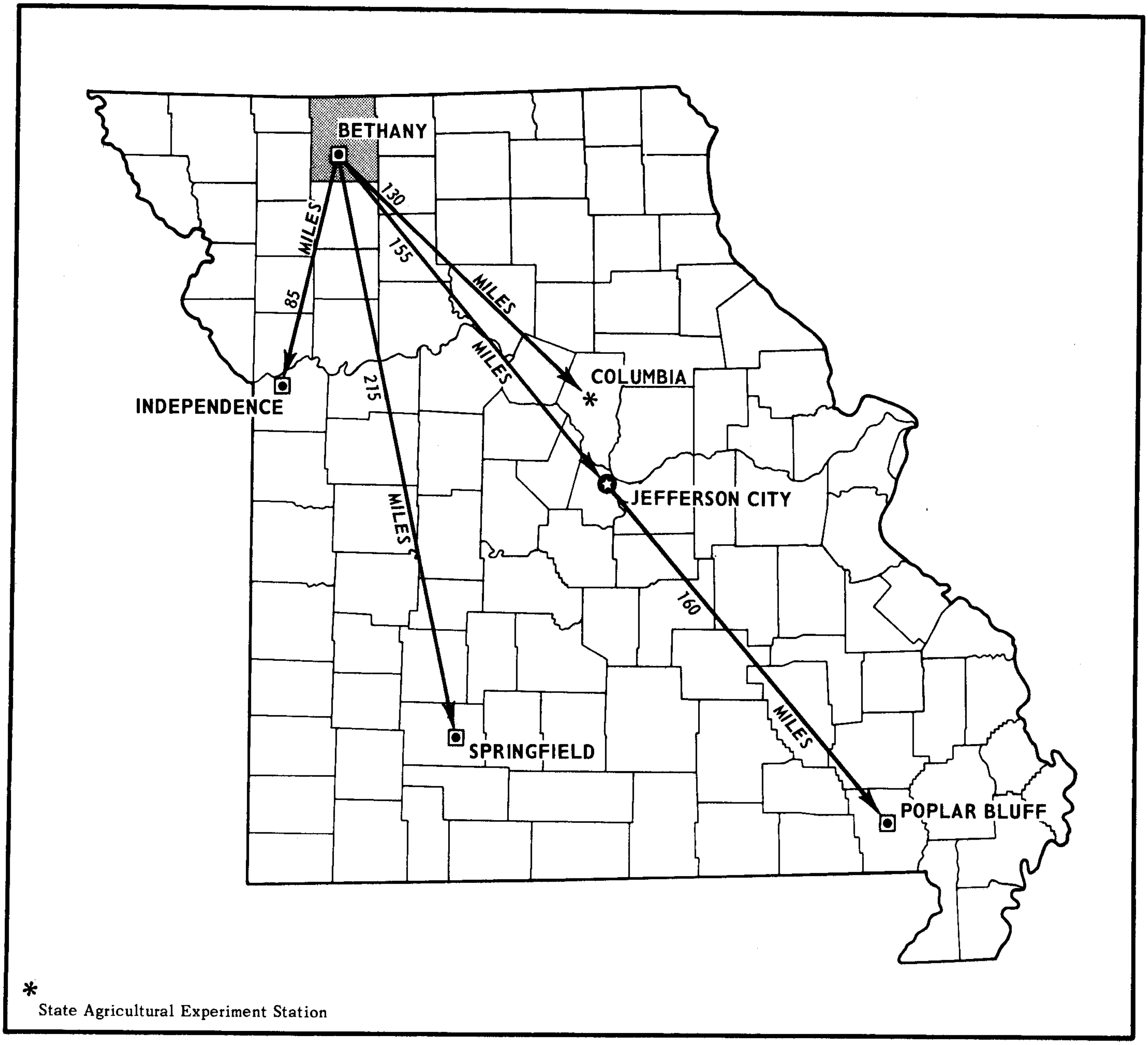
State Conservationist
Soil Conservation Service



Location of Harrison County in Missouri.

SOIL SURVEY OF HARRISON COUNTY, MISSOURI

By Paul E. Minor, Soil Conservation Service

Fieldwork by Paul E. Minor, Party Leader: Keith O. Davis, Galen E. Kintner, William R. Pauls, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in Cooperation with the Missouri Agricultural Experiment Station

HARRISON COUNTY is in the northwestern part of Missouri. It is within an area known as Rolling Prairie. The county borders Iowa to the north.

In 1970 the county had a population of 10,257. Bethany, the county seat, had a population of 2,914. The county has a total area of 460,800 acres, or 720 square miles.

Farming is the main enterprise in Harrison County. The main crops are corn, soybeans, legumes, and grasses. Raising beef cattle is the largest livestock enterprise; hogs, dairy cattle, and sheep are also raised. There are forested areas, mostly along the larger streams.

General nature of the county

In this section, climate, water supply, physiography, relief, drainage, history and development, and farming are discussed.

Climate

The climate of Harrison County is characterized by cold winters and long, hot summers. Heavy rains fall mainly in spring and summer when moist air from the Gulf of Mexico interacts with dry continental air. The annual rainfall generally is adequate for corn, soybeans, and all grain crops.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Bethany, Missouri, for the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season.

In winter the average temperature is 28 degrees F. The average daily minimum is 18 degrees, and the lowest recorded temperature is -29 degrees, which occurred at Bethany on January 12, 1974. In summer the average temperature is 75 degrees. The average daily maximum is 87 degrees, and the highest recorded temperature is 108 degrees, which occurred on July 17, 1954.

In table 1, growing degree days are equivalent to "heat units." Beginning in spring, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature of 50 degrees F. The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 25 inches, or 69 percent, usually falls in April through September, which is the growing season for most crops. In 2 years in 10, however, the rainfall is less than 19 inches in that period. The heaviest recorded rainfall for 1 day is 6.09 inches at Bethany on October 11, 1973. About 56 thunderstorms occur each year; of these, 28 occur in summer.

The average seasonal snowfall is 26.7 inches. The greatest recorded snow depth at any one time is 17 inches. On the average, 18 days have at least 1 inch of snow on the ground, but the number of days varies greatly from year to year.

In spring the average relative humidity in midafternoon is less than 55 percent; during the rest of the year it is about 60 percent. In all seasons the humidity is higher at night, and the average at dawn is about 80 percent. The percentage of possible sunshine is 73 percent in summer and 63 percent in winter. The prevailing direction of the wind is from the south. The highest average windspeed is 13 miles per hour and occurs in April.

Tornadoes and severe thunderstorms occur occasionally but are local and of short duration. The damage they cause varies and is spotty. Hailstorms occur during the warmer part of the year in an irregular pattern and in small areas.

Water supply

Most soils on the uplands in Harrison County are suitable for the construction of ponds and small lakes for use as water supply for household purposes and livestock.

Water from consolidated rock formations that underlie Harrison County generally is too mineralized even for irrigation (*4*). Moderately deep wells that reach into consolidated rock may yield limited amounts of water of marginal quality.

The streams in Harrison County flow intermittently. Therefore, they are not a dependable source of water for irrigation or municipal use.

The most important source of ground water is unconsolidated glacial deposits. The quality of the water from glacial drift material generally is acceptable. The water generally is high in total dissolved solids, iron, and sulfates.

Sufficient water for domestic needs can be obtained in nearly two-thirds of Harrison County. Water yields seldom exceed 15 gallons per minute (*4*). On about 17,000 acres the potential for developing irrigation wells is good; yields can range from 200 to 1,000 gallons per minute. Old channels and valleys of preglacial streams where deposits of sand and gravel are deep are the most suitable areas for high-producing wells. These wells range up to 400 feet deep.

Physiography, relief, and drainage

Most of Harrison County is gently rolling to hilly upland. Along the eastern border of the county, the Thompson River has formed a flood plain that on the average is 2 miles wide and extends the length of most of the county. East and west forks of Big Creek flow southward through the north central part of the county. They merge near Bethany and the flood plain broadens to more than 1 mile in the extreme southern part of the county.

A system of wide gently sloping ridges extends northward from the south central part of the county. The ridges narrow to the north and end near Blythedale.

The elevation ranges from 780 feet in the southeastern part of the county to 1,180 feet in the northwestern corner.

History and development

The first settlers came to what is now Harrison County in about 1838 and settled south of what is now Bethany and along Sugar Creek. The county was organized on February 14, 1845, and Bethany was laid out as the county seat (*13*).

Most of the early settlers lived along streams because they needed to be close to water and wood. About three-fourths of the county was in prairie grass, and one-fourth, mainly along the main streams, was in timber. The timbered soils were easier to cultivate than those in prairie grass, and large game was more abundant in and near the timbered areas.

Mining for coal started in a few places in about 1860. The Cainsville mine produced 800 to 900 tons of coal per day at one time. In 1885 a test boring, 654 feet deep, was made about a mile west of Bethany. It resulted in the discovery of five small veins of coal, one of which was 15 inches thick at a depth of 370 feet.

The population of Harrison County in 1880 was 20,304, and it reached a high of 24,398 in 1900. Since then, it steadily declined to 10,257 in 1970.

The first railroad, the Chicago, Burlington, and Quincy Railroad, was built from Iowa to Bethany in October 1890. It was later extended to Albany. Two other railroads were built later and served the county for many years.

The Chicago, Burlington, and Quincy Railroad now provides only limited service to Harrison County. Interstate 35 is the main north-south transportation route, and U.S. Highway 136 is the main east-west route.

In about 1900, cropping became more general, and erosion began to be a problem on the sloping soils. By 1930 erosion was a serious problem in the county.

In 1929 Congress appropriated funds to establish 10 experiment stations throughout the United States to investigate soil erosion. The Conservation Experiment Station in Bethany was established in 1930 and was the 5th of the original 10 stations. This station has helped to formulate national and worldwide guidelines for soil conservation practices.

In January 1944, after enactment of soil conservation district legislation, the Harrison County Soil and Water Conservation District was organized. It was the first soil and water conservation district in Missouri.

Farming

The first settlers in Harrison County raised a few cows and hogs and planted some corn for feed. The number of livestock and the acreage planted to crops increased rapidly after the Civil War and reached a peak around 1900. Production remained about the same up to 1970; a low point occurred in 1940.

In 1900, there were 3,836 farms in Harrison County. That number steadily declined and reached a low of 1,508 in 1964. In 1969, there were 1,572 farms in the county, and the average size of a farm was 273 acres (*3*).

Livestock produced about 76 percent of all farm products sold in 1969 (*3*). Cattle have increased sharply in number since 1965, hogs have remained steady, and sheep and poultry have decreased. In 1969 about 45 percent of Harrison County was cropland, 38 percent was permanent pasture, and 11 percent was woodland.

About 50 percent of the farmers have part-time jobs off the farm. About 31 percent work away from the farm 100 days or more out of the year.

The general trend in farming between 1955 and 1975 was to larger farms and fewer farmers and an increased use of fertilizer, chemicals, and large machinery.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length,

and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land-use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land use planning

The general soil map at the back of this publication shows, in color, map units that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

Descriptions, names, and delineations of soils in this survey do not fully agree with soil maps of adjacent counties published at a different date. Differences are the result of additional soil data, modifications in the series concept, intensity of mapping, and extent of the soils within the survey area. In some places it is more feasible to combine small acreages of similar soils that respond to use and management in much the same way than it is to separate these soils and give them different names.

Map unit descriptions

1. Shelby-Adair-Zook

Deep, nearly level to moderately steep, moderately well drained to poorly drained soils that formed in glacial till and alluvial sediment

The landscape of this map unit is characterized by narrow, nearly level and gently sloping bottom lands; narrow, moderately sloping ridgetops; and strongly sloping to moderately steep side slopes.

This map unit makes up about 30 percent of the county. It consists of about 46 percent Shelby soils, 25 percent Adair soils, 13 percent Zook soils, and 16 percent soils of minor extent.

Shelby soils are strongly sloping to moderately steep and are moderately well drained. They are on the sides of ridges. Adair soils are gently sloping to moderately sloping and are somewhat poorly drained. They are on the top and sides of narrow ridges. Zook soils are nearly level and are poorly drained. They are on narrow bottom lands.

Adair soils have a surface layer of loam or clay loam and a subsoil of clay and clay loam. Shelby soils have a surface layer of loam or clay loam and a subsoil of clay loam. Both soils are very erodible. Zook soils have a surface layer of silty clay loam and a subsoil of silty clay loam. Adair and Zook soils have a seasonal high water table.

The minor soils in this map unit are the poorly drained Colo soils on narrow bottom lands, the somewhat poorly drained Grundy, Lagonda, and Lamoni soils on the wider

ridges and upper side slopes, and the moderately well drained Gara soils near the large streams.

Most areas of this map unit are used for hay production and permanent pasture. Small grain and hay and pasture plants grow well. Corn and soybeans are grown on the top and upper sides of some ridges.

Erosion is the main limitation to use of the Shelby and Adair soils for farming and for most other purposes. There are many small severely eroded areas that need special conservation practices if they are farmed with adjoining uneroded areas. Wetness is the main limitation of Zook soils.

This map unit, with adequate terraces and crop rotations, has fair potential for cultivated crops on the ridgetops and some side slopes. It has good potential for grasses and legumes for pasture and hay. It also has good potential for the development of habitat for openland wildlife. Steep slopes and high shrink-swell potential are moderate to severe limitations for buildings and roads on Shelby and Adair soils, but proper design can overcome these limitations. High shrink-swell potential and wetness are severe limitations for small buildings and roads on Zook soils.

2. Gara-Pershing-Armstrong

Deep, gently sloping to moderately steep, moderately well drained and somewhat poorly drained soils that formed in loess and glacial till

The landscape of this map unit (fig. 1) is characterized by partly wooded, narrow areas on the top of ridges and strongly sloping and moderately steep hillsides that are adjacent to the larger streams.

This map unit makes up about 20 percent of the county. It consists of about 60 percent Gara soils, 14 percent Pershing soils, 12 percent Armstrong soils, and 14 percent soils of minor extent.

Gara soils are moderately sloping to moderately steep and are moderately well drained. They are on hillsides. Pershing soils are gently sloping to moderately sloping and are somewhat poorly drained. They are on the top and sides of narrow ridges. Armstrong soils are moderately sloping to strongly sloping and are somewhat poorly drained. They also are on the top and sides of narrow ridges.

Gara soils have a loam or clay loam surface layer and a clay loam subsoil. Pershing soils have a silt loam or silty clay loam surface layer and a silty clay loam and silty clay subsoil. Armstrong soils have a loam or clay loam surface layer and a clay and clay loam subsoil. All of these soils are very erodible.

The minor soils are the poorly drained Colo and Zook soils on narrow bottom lands, the somewhat poorly drained Lamoni soils near the head of small drainageways, the moderately well drained Shelby soils on side slopes, the moderately well drained Ladoga and Weller soils on low ridges near large streams, and the somewhat excessively drained, shallow Gasconade soils that are adjacent to streams.

Most areas of this map unit are in hay and permanent pasture; some small tracts are in trees. Small grain and hay and pasture plants grow well. Corn and soybeans are grown on the top and upper sides of some ridges.

Erosion is the main limitation to use of the soils for farming and for most other purposes. Many small areas are severely eroded and need special conservation practices if they are farmed with adjoining uneroded areas.

The potential is good for grasses and legumes for hay and pasture, for trees for use as timber, and for developing habitat for openland wildlife. Steep slopes and high shrink-swell potential impose moderate to severe limitations for buildings and roads.

3. Grundy-Lagonda

Deep, gently sloping and moderately sloping, somewhat poorly drained soils that formed in loess and in thin loess over glacial till

The landscape of this map unit (fig. 2) is characterized by wide, gently sloping ridges, moderately sloping side slopes, and narrow drainageways.

This map unit makes up about 20 percent of the county. It consists of about 53 percent Grundy soils, 37 percent Lagonda soils, and 10 percent soils of minor extent.

Grundy soils are gently sloping and are somewhat poorly drained. They are on the top of wide ridges. Lagonda soils are gently sloping to moderately sloping and are somewhat poorly drained. They are on the top and sides of ridges. Grundy soils are slightly higher in elevation than the Lagonda soils. Both soils have a surface layer of silt loam and silty clay loam and a subsoil of silty clay and silty clay loam. They are sticky when wet and erode easily.

The minor soils in this map unit are the somewhat poorly drained Adair and Lamoni soils on the steeper side slopes and the poorly drained Haig, Colo, and Zook soils. Haig soils are on wide nearly level ridges and Colo and Zook soils are in drainageways.

Most areas of this map unit are used for cultivated crops. Corn, soybeans, hay, and pasture plants grow well.

Erosion is the main limitation to use of these soils for farming. Surface wetness is a problem in the spring.

This map unit, with adequate terraces and crop rotations, has good potential for cultivated crops. The potential for growing grasses and some legumes for hay and pasture is good. Surface wetness and high shrink-swell potential are moderate to severe limitations for buildings and roads, but proper design can overcome these limitations.

4. Lamoni-Shelby-Zook

Deep, nearly level to strongly sloping, moderately well drained to poorly drained soils that formed in glacial till and alluvial sediment

The landscape of this map unit (fig. 3) is characterized by narrow, nearly level and gently sloping bottom lands;

narrow, moderately sloping ridgetops; and strongly sloping side slopes.

This map unit makes up about 17 percent of the county. It consists of about 36 percent Lamoni soils, 32 percent Shelby soils, 14 percent Zook soils, and 18 percent soils of minor extent.

Lamoni soils are moderately sloping and are somewhat poorly drained. They are on the top and sides of ridges. Shelby soils are mostly strongly sloping and are moderately well drained. They are on the sides of ridges. Zook soils are nearly level and are poorly drained. They are on the narrow bottom lands.

Lamoni soils have a clay loam surface layer and a clay and clay loam subsoil. Shelby soils have a loam or clay loam surface layer and a clay loam subsoil. Both soils are very erodible. Zook soils have a surface layer of thick silty clay loam and a subsoil of silty clay loam. Lamoni and Zook soils have a seasonal high water table.

The minor soils in this map unit are the poorly drained Colo soils on the narrow bottom lands, the somewhat poorly drained Adair, Grundy, and Lagonda soils, and the moderately well drained Gara soils. Grundy and Lagonda soils are on the wider ridges. Adair soils are on narrow ridges and Gara soils are on the steeper side slopes near streams.

Most areas of this map unit are used for hay production and permanent pasture. Corn and soybeans are grown on many of the ridgetops and upper sides of the ridges.

Erosion is the main limitation to use of the Lamoni and Shelby soils for farming and for most other purposes. There are many small severely eroded areas that need special conservation practices if they are farmed with adjoining uneroded areas. Wetness is the main limitation of Zook soils.

The soils on the ridgetops and on some side slopes, with adequate terraces and crop rotations, have fair potential for cultivated crops. This map unit has good potential for grasses and legumes for pasture and hay. It also has good potential for the development of habitat for openland wildlife. Steep slopes and high shrink-swell potential are moderate to severe limitations for dwellings, small buildings, and local roads and streets on Lamoni and Shelby soils, but proper design can overcome these limitations. High shrink-swell potential and wetness are severe limitations for buildings and roads on Zook soils.

5. Nodaway-Zook

Deep, nearly level, moderately well drained and poorly drained soils that formed in alluvial sediment

The landscape of this map unit (fig. 4) is characterized by medium and large flood plains. Many areas have abandoned old stream channels where the stream channels have been straightened.

This map unit makes up about 13 percent of the county. It consists of about 46 percent Nodaway soils, 24 percent Zook soils, and 30 percent soils of minor extent.

Nodaway soils are nearly level and are moderately well drained. They are on flood plains adjacent to natural stream channels. Zook soils are nearly level and are poorly drained. They are commonly some distance from the stream channel in the slack-water areas of the flood plains. Nodaway soils have a surface layer of friable silt loam. Zook soils have a surface layer of thick silty clay loam and a subsoil of silty clay. They are sticky when wet and have a seasonal high water table.

The minor soils in this map unit are the poorly drained Colo and Humeston soils and the very poorly drained Wabash soils. Colo soils are adjacent to the ends of small drainageways. Humeston soils are between Nodaway and Zook soils, and Wabash soils are in ponded areas. Some small sandy areas are near some stream channels.

Most areas of this map unit are used for cultivated crops. Corn and soybeans grow well. Some swampy areas and low areas that are subject to flooding are used for permanent pasture and trees.

Flooding and wetness are the main limitations to use of these soils for farming and for most other purposes.

This map unit, with some landgrading and drainage ditches, has good potential for cultivated crops. It has good potential for timber and development of habitat for wetland wildlife. Wetness and flooding are severe limitations to community development and would be difficult to overcome in most areas.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have a profile that is almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic

feature near the place where a soil of that series was first observed and mapped. Grundy and Shelby, for example, are the names of two soil series.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Gara loam, 9 to 14 percent slopes, is one of several phases within the Gara series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Zook-Colo silty clay loams, channeled, is an example.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Pits, quarries, is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Soil descriptions

AdC—Adair loam, 3 to 9 percent slopes. This is a gently sloping and moderately sloping, somewhat poorly drained soil on the top and side slopes of ridges. The areas are long, narrow, and irregular in shape and range from 7 to 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 12 inches thick. The subsoil is about 24 inches thick. In the upper 5 inches it is dark grayish brown, mottled, firm clay loam; in the next 9 inches it is dark brown and yellowish brown, mottled, firm clay; in the lowermost 10 inches it is yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 73 inches, is yellowish brown, mottled, firm clay loam. In some places the subsoil contains less clay and is thinner. Also, in some places on the wider ridgetops, the surface layer is silt loam.

Included with this soil in mapping are a few small areas of moderately well drained Shelby soils. These soils are in the steeper areas and make up about 5 to 12 percent of this map unit.

Permeability is slow, and surface runoff is slow to medium. The available water capacity is high. The content of organic matter and natural fertility are high. This soil has moderate to high shrink-swell potential. Its surface layer is friable and easily tilled but only within a fairly narrow range of moisture content.

Most areas of this soil are farmed. The soil has good potential for cultivated crops, hay, and pasture. It has poor potential for most engineering uses.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. There is a hazard of erosion if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent serious damage from erosion. Most areas have long smooth slopes that are well suited to terracing and farming on the contour. Crop residue left on the surface helps control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion on this soil. Overgrazing pastures will reduce future yields of grasses and legumes and increase weed growth. Grazing when the soil is too wet will cause surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods will help maintain the pasture and soil in good condition.

This soil is suitable for sewage lagoons and area-type sanitary landfills if proper design and installation procedures are used. Wetness is a limitation for recreational development, but this limitation can be overcome by resurfacing areas subject to heavy foot traffic with fine gravel or other suitable material. High shrink-swell is a severe limitation to community development. Properly designed footings, basement walls, and adequate base material for streets and driveways are needed to prevent the damage to structures and roads caused by shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Capability unit IIIe-5.

AeC2—Adair clay loam, 5 to 9 percent slopes, eroded. This is a moderately sloping, somewhat poorly drained soil in bands on the shoulder of convex side slopes and on the top of some ridges. Most areas are narrow and irregular in shape and range from 15 to 80 acres in size.

Typically, the surface layer is very dark grayish brown clay loam about 7 inches thick. The subsoil is about 25 inches thick. In the upper 5 inches it is dark grayish brown, mottled, firm clay loam; in the next 13 inches, it is dark brown and dark yellowish brown, mottled, firm clay;

in the lowermost 8 inches it is yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 77 inches, is yellowish brown, mottled, firm clay loam. In some places the subsoil contains less clay and is thinner. Also, in several places where plowing has mixed the upper part of the subsoil with the original surface layer the present surface layer is brown.

Included with this soil in mapping are a few small areas of moderately well drained Shelby or Gara soils. These soils are in the steeper areas and make up about 5 to 12 percent of this map unit.

Permeability is slow, and surface runoff is medium. The available water capacity is moderate. The content of organic matter is moderate, and natural fertility is medium. This soil has moderate to high shrink-swell potential. The surface layer is sticky when wet. It is very sticky when wet in areas where the plow layer consists mainly of subsoil material.

Most areas of this soil are farmed. The soil has fair potential for cultivated crops and good potential for hay and pasture. It has poor potential for most engineering uses.

This soil is suited to corn and soybeans and is well suited to small grains and to grasses and legumes for hay and pasture. There is a hazard of erosion if this soil is used for cultivated crops. Areas where the plow layer is mostly subsoil material are best suited to hay and pasture or to use as wildlife habitat. Minimum tillage, winter cover crops, and contour farming and grassed waterways can help prevent serious erosion on cropland. Some areas have long smooth slopes that are suited to terracing and farming on the contour. Proper management of crop residue helps control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture or hay is very effective in controlling erosion on this soil. Overgrazing pastures will reduce future yields of grasses and legumes and increase weed growth. Grazing when the soil is too wet will cause surface compaction and poor tilth and increase runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods will help maintain the pasture and soil in good condition.

This soil is suitable for sewage lagoons if proper design and installation procedures are used. Wetness is a limitation for recreational development, but this limitation can be overcome by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material. A few eroded areas, however, where the surface is mostly subsoil material, should be protected by a permanent vegetative cover. High shrink-swell is a severe limitation to community development. Properly designed footings and basement walls and adequate base material for streets and driveways are needed to prevent the damage to structures and roads caused by shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Capability unit IIIe-5.

AmC—Armstrong loam, 5 to 9 percent slopes. This is a moderately sloping, somewhat poorly drained soil on ridgetops and on the sides of ridges. The areas are narrow and irregular in shape and range from 10 to 60 acres in size.

Typically, the surface layer is black loam about 6 inches thick. The subsoil is about 26 inches thick. In the upper 10 inches it is brown and dark grayish brown, mottled, firm clay loam; in the lower 16 inches it is dark grayish brown and yellowish brown, mottled, firm clay. The underlying material, to a depth of 60 inches, is grayish brown and yellowish brown, calcareous, firm clay loam. In some places the surface layer is silt loam and the upper part of the subsoil is silty clay. In a few small areas the surface layer is less than 5 inches thick.

Included with this soil in mapping are small areas of moderately well drained Gara soils. These soils are on the narrow ends of ridges and on the steeper slopes. They make up about 5 to 15 percent of this map unit. Also included are a few small areas of eroded Armstrong soils that have a clay loam surface layer. These soils are on the shoulder of the side slopes and make up about 5 percent of this map unit.

Permeability is slow, and runoff is medium. The available water capacity is moderate. The organic matter content also is moderate, and natural fertility is medium. The shrink-swell potential is moderate to high. The surface layer is friable and is easily tilled if moisture conditions are favorable.

Most areas of this soil are farmed. The soil has fair potential for cultivated crops and good potential for hay, pasture, and trees. It has poor potential for most engineering uses.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. There is a hazard of erosion if this soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways help prevent serious damage by erosion. Many areas have long smooth slopes that are suited to terracing and farming on the contour. Proper management of crop residue and green manure crops can help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion on this soil. Overgrazing pastures will reduce future yields of grasses and legumes and increase weed growth. Grazing when the soil is too wet will cause surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods will help maintain the pasture and soil in good condition.

This soil is suited to trees; in some small areas there are stands of native hardwoods. There are only slight limitations to be concerned about in planting or harvesting trees.

This Armstrong soil has a moderate limitation for recreational development because of wetness. This limita-

tion can be overcome, however, by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable materials. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small buildings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Drainage tiles can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to properly designed sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IIIe-5.

AmD—Armstrong loam, 9 to 14 percent slopes. This is a strongly sloping, somewhat poorly drained soil on lower side slopes adjacent to drainageways. The areas are irregular in shape and range from about 10 to more than 70 acres in size.

Typically, the surface layer is black or very dark grayish brown loam about 6 inches thick. The subsoil is about 24 inches thick. In the upper 12 inches it is brown and dark grayish brown, mottled, firm clay loam; in the next 14 inches it is dark grayish brown and yellowish brown, mottled, firm clay. The underlying material, to a depth of 65 inches, is grayish brown and yellowish brown, calcareous, firm clay loam. In several places the surface layer is less than 5 inches thick.

Included with this soil in mapping are a few small areas of Gasconade soils and rock outcrop. The areas are on the lower side slopes adjacent to the larger drainageways or bottom lands and make up less than 5 percent of this map unit.

This Armstrong soil has slow permeability. Runoff is medium. The available water capacity is moderate. The content of organic matter is moderate, and natural fertility is medium. The shrink-swell potential is moderate to high. The surface layer is friable and is easily tilled if moisture conditions are favorable.

Most areas of this soil are used for hay and pasture. The soil has fair potential for cultivated crops and good potential for hay, pasture, and trees. It has poor potential for most engineering uses.

This soil is suited to hay and pasture and, to a limited extent, to row crops and small grains. There is a hazard of serious erosion if this soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive damage by erosion. Most areas are not suited to terracing because of steep slopes; tillage and seeding operations need to be on the contour. Proper management of crop residue and green manure crops help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion on this soil. Overgrazing pastures can reduce future yields of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture in good condition.

This soil is suited to trees; in some small areas there are stands of native hardwoods. There are only slight limitations to be concerned about when planting or harvesting trees.

This Armstrong soil has moderate limitations for most recreation uses because of wetness; it has severe limitations for playgrounds because of the steep slope. The limitation resulting from wetness can be overcome by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent structural damage from the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to commercial sewers or piped to adjacent areas that are suitable for lagoons. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IVe-5.

ArC3—Armstrong clay loam, 5 to 9 percent slopes, severely eroded. This is a moderately sloping, somewhat poorly drained soil on the shoulders of side slopes. The areas are narrow and irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer consists mostly of subsoil material. It is brown clay loam about 7 inches thick. The subsoil is about 21 inches thick. In the upper 5 inches it is dark grayish brown, mottled, firm clay loam; in the lower 16 inches it is dark grayish brown and yellowish brown, mottled, firm clay. The underlying material, to a depth of 60 inches, is grayish brown and yellowish brown, calcareous, firm clay loam. In a few places, the surface layer is very dark grayish brown loam.

Included with this soil in mapping are several small areas of moderately well drained Gara soils. These soils are on the steeper slopes and make up about 5 to 15 percent of the mapped areas of this unit.

This Armstrong soil has slow permeability. Runoff is rapid. The available water capacity is moderate. The organic matter content and natural fertility are low. This soil has moderate to high shrink-swell potential. Its surface layer is sticky when wet and tillage is difficult except under optimum moisture conditions.

Most areas of this soil are in hay or pasture. A few areas are used for cultivated crops. This Armstrong soil has poor potential for row crops and fair potential for small grains, hay, and pasture. It has good potential for trees and for use as wildlife habitat. It has poor potential for most engineering uses.

This soil is suited to hay and pasture. The hazard of erosion is severe if the soil is used for cultivated crops. Terracing is difficult in many areas because of previous severe damage by erosion. To prevent excessive erosion if row crops are grown, minimum tillage, winter cover crops, and grassed waterways are essential. Crop residue

left on the surface helps reduce erosion, maintain the organic matter content, and increase water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion on this soil. Overgrazing pastures will reduce future yields of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods will help maintain the pasture and soil in good condition.

This soil is suited to trees. There are only slight limitations to be concerned about when planting or harvesting trees.

This Armstrong soil is well suited to development of habitat for openland and woodland wildlife. There are some limitations to be concerned about when establishing food plots because of slope and the texture of the surface layer. These limitations, however, can be reduced by timely seeding and proper management to control erosion.

Wetness imposes moderate limitations to recreational development, but it can be corrected by resurfacing areas that are subject to heavy foot traffic with fine gravel or other desirable material. This soil has severe limitations for building sites because of wetness, high shrink-swell potential, and clayey surface material. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent structural damage from the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to properly designed sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IVe-8.

Co—Colo silty clay loam. This is a nearly level, poorly drained soil on low benches and alluvial fans of the large flood plains that are adjacent to the uplands. It is subject to occasional flooding. The areas are narrow and long or are fan shaped and range from 20 to more than 100 acres in size.

Typically, the surface layer is black silty clay loam about 35 inches thick. The underlying material, to a depth of 62 inches is very dark gray silty clay loam. In some small areas the surface layer is silt loam or loam, and in a few depressional areas adjacent to the lower bottom lands, the surface layer is more sticky, and runoff is very slow.

This Colo soil has moderately slow permeability. Runoff is slow. The available water capacity is high. The organic matter content and natural fertility also are high. The soil has high shrink-swell potential. The surface layer is friable and is easily tilled if moisture conditions are favorable.

Most areas of this soil are farmed. The soil has good potential for cultivated crops, hay, and pasture. It has poor potential for most engineering uses.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Occasional flooding and hillside runoff are problems in most areas. Diversions help control runoff from the uplands. Wet areas can be drained by shallow ditches, or they can be filled by land leveling. Proper management of crop residue can help improve tilth and increase water infiltration.

Overgrazing pastures will reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This soil is suited to development of habitat for openland wildlife. There are no hazards or limitations to be concerned about when establishing food and cover plants for wildlife.

This soil has severe limitations for recreational facilities and building sites because of occasional flooding and the wetness and high shrink-swell potential of the soil. Dwellings or small buildings constructed on this soil need protection from flooding and surface runoff; extreme precautions in design are necessary. Capability unit IIw-2.

GaC—Gara loam, 5 to 9 percent slopes. This is a moderately sloping, moderately well drained soil on the sides of ridges and on narrow ridgetops. Individual areas are narrow and irregular in shape and range from 5 to 70 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is about 37 inches thick. The upper part is brown and dark yellowish brown clay loam, and the lower part is yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 66 inches, is mottled yellowish brown and grayish brown, calcareous, firm clay loam. In some places the surface layer is silt loam, and in other places it is less than 6 inches thick.

Included with this soil in mapping are small areas of somewhat poorly drained Armstrong and Pershing soils. Pershing soils are on the wider, less sloping part of the ridgetops, and Armstrong soils are on side slopes. These soils make up 5 to 15 percent of this map unit.

Permeability is moderately slow, and runoff is medium. The available water capacity is high. The content of organic matter is moderate, and natural fertility is medium. The shrink-swell potential is moderate. The surface layer is friable, and it is tilled easily within a fairly wide range of moisture content.

Most areas of this soil are farmed. The soil has fair potential for cultivated crops and good potential for hay, pasture, and trees. It has fair to poor potential for most engineering uses.

This soil is moderately well suited to small grains and well suited to grasses and legumes for hay and pasture. It has fair suitability for 1-year row crops in rotation with grasses. There is a severe hazard of erosion if the soil is

used for continuous cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent damage from erosion. Some areas have long smooth slopes suited to terracing and farming on the contour. Proper management of crop residue and green manure crops help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion on this soil. Overgrazing pastures will reduce future yields of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This soil is suited to trees; in some small areas there are stands of native hardwoods. There are only slight limitations to planting or harvesting trees.

This Gara soil has some moderate limitations for recreational development because of slow percolation and slope. Camp areas and playgrounds should be located only in selected areas on the lesser slopes and where runoff can be diverted. This soil has moderate limitations for building sites. The main problem is the shrink-swell potential of the soil. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent damage to the structure from the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IIIe-1.

GaD—Gara loam, 9 to 14 percent slopes. This is a strongly sloping, moderately well drained soil on the side slopes of narrow, dissected ridges. The areas are irregular in shape and range from 10 to more than 80 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is about 30 inches thick. In the upper part it is dark brown, firm clay loam; and in the lower part it is dark yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 62 inches, is mottled, grayish brown and dark yellowish brown, calcareous firm clay loam. In several places, on the upper part of the slope, erosion has removed most of the original surface layer, and the present surface layer consists mainly of subsoil material. It is brown clay loam. These areas make up about 5 to 10 percent of the unit.

Included with this soil in mapping are small areas of Armstrong soils. These soils are near the head of drainageways and make up 5 to 10 percent of this map unit.

Permeability is moderately slow, and runoff is medium. The available water capacity is high. The content of organic matter is moderate, and natural fertility is medium. The shrink-swell potential is moderate. The surface layer is friable, and it can be tilled easily within a fairly wide range of moisture conditions.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops and good potential for hay, pasture, and trees. It has fair to poor potential for most engineering uses.

This soil is moderately well suited to small grains and well suited to hay and pasture. It has fair suitability for 1-year row crops in rotation with grasses. The hazard of erosion is severe if the soil is used continuously for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent damage from erosion. Some areas have long smooth slopes that are suited to terracing and farming on the contour. Proper management of crop residue and green manure crops help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for hay and pasture is effective in controlling erosion on this soil. Overgrazing pastures will reduce future yields of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This soil is suited to trees; in some areas there are stands of native hardwoods. There are only slight limitations to planting or harvesting trees.

This Gara soil has moderate to severe limitations for recreational development because of the steep slopes. Slopes are too steep for playgrounds. The shrink-swell potential of the soil is a moderate limitation for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent damage to the structure by the shrinking and swelling of the soil. Drainage tile can be used to help prevent damage from excessive wetness. Sanitary facilities should be connected to commercial sewers or piped to adjacent areas that are suitable for lagoons. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IVe-1.

GaE—Gara loam, 14 to 20 percent slopes. This is a moderately steep, moderately well drained soil on side slopes of narrow dissected ridges. The areas are irregular in shape and range from 7 to 80 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is about 34 inches thick. In the upper part it is brown and dark yellowish brown, firm clay loam, and in the lower part it is yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 68 inches, is gray and strong brown, calcareous, firm clay loam. In several places most of the original surface layer has been removed by erosion, and the present surface layer is now brown clay loam.

Included with this soil in mapping are a few small areas of shallow Gasconade soils and rock outcrops. The areas

are on the lower side slopes adjacent to the larger drainageways or bottom lands and make up less than 5 percent of the unit.

Permeability is moderately slow, and runoff is rapid. The available water capacity is high. The content of organic matter is moderate, and natural fertility is medium. The shrink-swell potential is moderate. The surface layer is friable, and it can be tilled easily within a fairly wide range of moisture conditions.

Most areas of this soil are pastureland or hayland or are in trees. This soil has good potential for grasses, legumes, and trees. It has poor potential for most engineering uses.

This soil is too steep for use as cropland and should be tilled only when needed in reseeding grasses and legumes. Timely use of minimum tillage is necessary to prevent damage from severe erosion. Seed should be planted early so that a good ground cover can be established before the end of the growing season. Nurse crops can be used to provide cover late in fall and in winter until the grasses and legumes get established.

Overgrazing pastures can reduce yields of grasses and legumes and increase weed growth. Grazing when the soil is too wet can cause surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This soil is well suited to trees; in some areas there are stands of native hardwoods. There is a hazard of erosion and moderate limitations to the use of equipment because of the steepness of slopes. These limitations can be overcome to some extent by proper management of ground cover to control erosion and by using equipment only when the surface of the soil is dry and firm.

This soil has severe limitations for building sites because of the steepness of slope and moderate limitations because of the shrink-swell potential of the soil. If dwellings are built on this soil, they should be properly designed to prevent structural damage to foundations and basement walls by the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Also, provisions are needed to prevent or divert rapid runoff. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit VIe-1.

GbD3—Gara clay loam, 9 to 14 percent slopes, severely eroded. This is a strongly sloping, moderately well drained soil on side slopes of narrow dissected ridges. The areas are irregular in shape and range from 7 to 40 acres in size.

Typically, the surface layer consists mostly of subsoil material. It is brown clay loam about 7 inches thick. The subsoil is about 31 inches thick. In the upper part it is dark yellowish brown and yellowish brown, firm clay loam, and in the lower part it is yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 60 inches, is grayish brown and strong brown, calcareous, firm clay loam. In several places the surface layer is very dark grayish brown loam 5 to 8 inches thick.

Permeability is moderately slow, and runoff is rapid. The available water capacity is high. The organic matter content is low, and natural fertility is medium. The shrink-swell potential is moderate. The surface layer is sticky when wet, and tillage is difficult except under optimum moisture conditions.

Most areas of this soil have been heavily farmed, but because of severe damage by erosion the soil has only fair potential for hay, pasture, and trees. This soil has a fair to good potential for development of habitat for openland and woodland wildlife. It has fair to poor potential for most engineering uses.

This soil is suited to grasses and legumes for hay and pasture. It is subject to further severe erosion if it is used for cultivated crops. When reseeding grasses and legumes, minimum tillage, winter cover crops, and grassed waterways can help control erosion. If this soil is used for small grains, proper management of crop residue can help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Overgrazing pastures will reduce yields of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. There are only slight limitations to planting or harvesting trees. Small gullies in a few areas need to be reshaped and seeded to grass to provide cover until trees are established.

This Gara soil is suitable for development of habitat for openland and woodland wildlife. It has some limitations for food-plot seeding because of slope. These limitations can be reduced by timely seeding and proper management to control erosion.

This Gara soil has moderate to severe limitations for recreational development because of steep slopes. Slopes are extremely steep for playgrounds but present only moderate problems for most other recreation uses. Small areas would have to be leveled and runoff diverted.

This soil has moderate limitations for building sites. The main problems are steepness of slope and shrink-swell potential of the soil. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent structural damage from the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to commercial sewers or piped to adjacent areas that are suitable for lagoons. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IVe-4.

GeF—Gasconade flaggy silty clay loam, 14 to 30 percent slopes. This is a shallow, somewhat excessively

drained soil on steep areas adjacent to the flood plains of the larger streams and their tributaries. The areas are narrow, long, and irregular in shape and range from 20 to 70 acres in size.

Typically, the surface layer is black, firm flaggy silty clay loam about 6 inches thick. The subsoil is very dark grayish brown, firm, flaggy silty clay about 7 inches thick. Fractured limestone bedrock is at a depth of 13 inches. In some small areas the soil is slightly more than 20 inches deep to bedrock.

Included with this soil in mapping are a few areas of shallow soils that are underlain by soft shale and a few areas of deep, moderately well drained Gara soils. The Gara soils are on the fringes upslope from the Gasconade soils. Also included are a few small areas of large loose rocks and some bedrock outcrops.

Permeability in this Gasconade soil is moderately slow, and runoff is rapid. The available water capacity is low. The organic matter content is moderate, and natural fertility is low. The soil material above bedrock has 35 to 50 percent flaggy limestone fragments that are greater than 3 inches in diameter. The fine soil material is sticky when wet. Because of these soil properties all areas are difficult to till or reseed.

Most areas of this soil are in trees or wooded pasture. The soil has fair potential for trees and wildlife habitat. It has poor potential for cultivated crops, hay, pasture, and all engineering uses.

Growing trees for timber is effective in controlling erosion on this soil. The main problems in planting and harvesting trees are the hazard of erosion when ground cover is removed and the difficulty in using equipment because of the steep slopes and rock outcrops. Not overgrazing wooded pastures and protecting them from fire will insure a continuous ground cover. Crawler-type equipment can be used to overcome the problems imposed by the steep slopes. Seedling mortality is moderate because of the shallow root zone and droughtiness. The limitations can be overcome somewhat by timely planting and protection from fire and grazing.

Gasconade soils are fairly well suited to wildlife habitat. The main problem is difficulty in establishing plants for food and cover. Timely planting of grasses, grains, and trees and protection from grazing and fire help to overcome this problem. Food plots can be planted on the fringe areas or on adjacent soils that are better suited.

This soil has severe limitations for building sites because of the steep slopes and shallow depth to bedrock. Most buildings are constructed on adjacent soils. Capability unit VIIs-7.

GsB—Grundy silt loam, 2 to 5 percent slopes. This is a gently sloping, somewhat poorly drained soil on the top and on side slopes of wide ridges and on high benches. The areas are irregular in shape. Some are long and narrow, others are more than a fourth of a mile wide. They range from 10 to several hundred acres in size.

Typically, the surface layer is black, friable silt loam and silty clay loam about 11 inches thick. The subsoil is dark grayish brown, and grayish brown, mottled, firm silty clay and silty clay loam about 42 inches thick. The underlying material, to a depth of 72 inches, is olive gray, mottled, silty clay loam. In some small areas the surface layer is less than 10 inches thick.

Included with this soil in mapping are a few small areas of poorly drained Haig soils. These nearly level soils are on the crest of wide ridges.

Permeability is slow in this Grundy soil. Runoff is slow. The available water capacity, the organic matter content, and natural fertility are high. The shrink-swell potential is high. The surface layer is friable, but it is tilled easily only within a moderate range of moisture content.

Most areas of this soil are farmed. The soil has good potential for cultivated crops, hay, and pasture (fig. 5). It has poor to fair potential for most engineering uses.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. There is a hazard of erosion if the soil is used continuously for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help control erosion. Most areas are suited to terracing and farming on the contour. Proper management of crop residue and green manure crops can help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing will reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet will cause surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods will help maintain the pasture and soil in good condition.

This Grundy soil has a moderate limitation for recreation use because of wetness. This limitation can be overcome, however, by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be properly designed to prevent structural damage from shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to properly designed sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IIe-5.

GuB2—Grundy silty clay loam, 2 to 5 percent slopes, eroded. This is a gently sloping, somewhat poorly drained soil on long side slopes near the head of small drainageways and on high benches. The areas range from 10 to more than 100 acres in size.

Typically, the surface layer is very dark gray or very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 47 inches thick. The upper part is dark grayish brown, mottled, firm silty clay, and the lower part is dark grayish brown and olive gray, mottled,

firm silty clay loam. The underlying material, to a depth of 74 inches, is grayish brown, mottled, silty clay loam. In a few small places the surface layer is more than 10 inches thick. Also, in a few places the present surface layer is dark grayish brown silty clay loam because plowing has mixed the upper part of the subsoil with the original surface layer.

Permeability in this Grundy soil is slow, and runoff is medium. The available water capacity is high. The content of organic matter is medium, and natural fertility is high. The shrink-swell potential is high. The surface layer is friable, but it can be tilled easily only within a moderate range of moisture conditions.

Most areas of this soil have been heavily farmed, but because of the long slopes and damage by erosion, this soil has only fair potential for row crops unless terraces and contour farming are used. It has good potential for small grains, hay, and pasture, and poor to fair potential for most engineering uses.

This soil is suited to corn and soybeans and is well suited to small grains and grasses and legumes for hay and pasture. It is subject to further damage by erosion if it is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help control erosion. Most areas are suited to terracing and farming on the contour. Proper management of crop residue and green manure crops can help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is wet will cause surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This Grundy soil has moderate limitations for recreation use because of wetness. The wetness can be corrected by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material. Wetness, frost action, and high shrink-swell potential are severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent damage to the structure from the shrinking and swelling of the soil. Drainage tile can be used to help prevent damage from excessive wetness. Sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IIIe-5.

Ha—Haig silt loam. This is a nearly level, poorly drained soil on wide ridgetops and on high benches adjacent to the bottom lands.

Typically, the surface layer is about 13 inches thick. In the upper part it is black, friable silt loam, and in the lower part it is very dark gray friable silty clay loam. The subsoil is about 59 inches thick. In the upper part it is very dark gray, mottled, firm silty clay loam and silty clay; in the middle part it is dark gray, mottled, firm silty clay; and in the lower part it is grayish brown, mottled, firm silty clay loam. The underlying material, to a depth of 84 inches, is gray, firm silty clay loam. In a few places the lower part of the surface layer is grayish brown silt loam.

Permeability in this Haig soil is very slow. Runoff is very slow. The available water capacity is high. The organic matter content and natural fertility are high. The shrink-swell potential is high. The surface layer is friable, but it is tilled easily only under favorable moisture conditions. It puddles easily if worked when wet.

Most areas of this soil are farmed. The soil has good potential for cultivated crops, hay, pasture, and habitat for wetland wildlife. It has poor potential for most engineering uses.

This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. Minimum tillage and the use of crop residue can help maintain or increase the organic matter content, improve tilth, and increase water infiltration. In many places, early planting is delayed because of ponded areas and very slow runoff. Land grading and the installation of shallow surface ditches to remove excess surface water help to overcome these problems.

If this soil is used for hay and pasture, wet areas are a problem, and the grass stand will decrease as weeds take over. Land smoothing and the installation of shallow surface ditches help to overcome these problems. Overgrazing will reduce future yields and increase weed growth. Grazing when the soil is too wet can cause surface compaction, poor tilth, and reduction of the stand of grasses or legumes. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This soil is suited to development of habitat for wetland wildlife. There are no hazards or limitations to establishing food and cover plants for wildlife. Small shallow water areas can be easily constructed.

This soil has severe limitations for recreation uses and for building sites because of wetness, high shrink-swell potential, and the thick, clayey subsoil. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent damage to the structure from shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IIw-2.

Hu—Humeston silt loam. This is a nearly level, poorly drained soil on flood plains of small and large streams and on low stream terraces. It is subject to occasional flooding. The areas are narrow and long and range from 10 to 100 acres in size.

Typically, the surface layer is about 23 inches thick. In the upper 17 inches it is black, friable silt loam, and in the lower 6 inches it is gray, very friable silt loam. The subsoil is firm silty clay loam about 44 inches thick. It is dark gray in the upper part and very dark gray in the lower part. In several large areas the upper part of the surface layer is only about 8 inches thick. Also, in a few areas the surface layer is very dark grayish brown loam.

Included with this soil in mapping are several small areas of poorly drained Zook soils. These soils have a silty clay loam surface layer that is sticky when wet. They occupy the depressions.

Permeability is very slow in this Humeston soil. Runoff is very slow. The available water capacity is high. The organic matter content and natural fertility are high. The shrink-swell potential is moderate in the surface layer and high in the subsoil. The surface layer is friable, and it is tilled easily only within a moderate range of moisture content. It puddles easily if worked when wet.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and the development of wildlife habitat. It has poor potential for most engineering uses.

This soil is suited to corn, soybeans, small grains, and grasses and legumes. If this soil is used for crops, occasional flooding and wetness are the main problems. Land leveling and properly installed shallow ditches can correct surface drainage. Minimum tillage and returning crop residue to the surface help maintain or increase the organic matter content, improve tilth, and increase water infiltration.

There are problems if this soil is used for hay and pasture because the soil is subject to occasional flooding and low areas are wet. Land smoothing and installing shallow ditches can help overcome these problems. Overgrazing or grazing when the soil is too wet causes surface compaction, poor tilth, and a reduced stand of grasses or legumes. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This Humeston soil has severe limitations for recreation uses and for building sites because of flooding, wetness, and high shrink-swell potential. If dwellings or small buildings are constructed on this soil, protection from flooding and extreme precautions in design are necessary.

This soil is suited to use as wildlife habitat. There are no limitations to the development of wetland wildlife. There are moderate limitations to establishing grasses, shrubs, and trees for other wildlife because of wetness, but improving surface drainage in the wet areas helps to overcome the limitations. Capability unit IIIw-1.

LaC—Ladoga silt loam, 5 to 9 percent slopes. This is a moderately sloping, moderately well drained soil on ridgetops and side slopes of ridges. The areas are narrow and irregular in shape and range from 7 to 50 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 55 inches thick. It is mainly dark yellowish brown, mottled, firm silty clay loam and light silty clay. The underlying material, to a depth of 84 inches, is yellowish red, firm silty clay loam. In some areas the plow layer is dark grayish brown silt loam because plowing has mixed the upper part of the subsoil with the surface layer. Also, in some areas slopes are less than 5 percent.

Included with this soil in mapping are some small areas of somewhat poorly drained Pershing soils. These soils are in less sloping areas on the crest of wider ridges and near the head of drainageways. They make up about 7 percent of this map unit.

Permeability is moderately slow, and runoff is medium. The available water capacity is high. The organic matter content is moderate, and natural fertility is medium. The shrink-swell potential is moderate. The surface layer is friable; it can be easily tilled within a moderate range of moisture conditions.

Most areas of this soil are farmed. A few areas are in timber. This soil has fair potential for cultivated crops and good potential for hay, pasture, trees, and wildlife habitat. It has fair to poor potential for most engineering uses.

This soil has fair suitability for corn, soybeans, and small grains and is well suited to grasses and legumes for hay and pasture. There is a hazard of severe erosion if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent damage from erosion. Many areas are suited to terracing and farming on the contour, which also help prevent damage from erosion. Proper management of crop residue and green manure crops help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing will reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This soil is well suited to trees; a few areas remain in native hardwoods. Seedlings survive and grow well if competing vegetation is controlled or removed by site preparation and spraying or cutting.

Ladoga soils are well suited to development of habitat for openland and woodland wildlife. There are no limitations to establishing food and cover plants for wildlife.

This soil has moderate limitations for camp areas and playgrounds because of slow percolation. Play areas and walkways may require resurfacing. Ladoga soils have moderate limitations for building sites. Basement walls, foundations, and footings for dwellings and small buildings should be designed to prevent structural damage caused by shrinking and swelling of the soils.

Drainage tile can be used to prevent damage from excessive wetness. All sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface will have to be covered with base material if local roads and streets are to function properly. Capability unit IIIe-1.

LgB—Lagonda silt loam, 2 to 5 percent slopes. This is a gently sloping, somewhat poorly drained soil on the top and side slopes of ridges. The areas are narrow and about one-fourth to one-half mile in length and range from 10 to 50 acres in size.

Typically, the surface layer is black silt loam about 11 inches thick. The subsoil is about 57 inches thick. In the upper part it is dark grayish brown, mottled, firm silty clay loam; in the middle part it is grayish brown, mottled, firm silty clay; and in the lower part it is yellowish brown, mottled, firm silty clay. The underlying material, to a depth of 74 inches, is yellowish brown and gray, firm clay loam. In a few small places the surface layer is loam, and the subsoil has a few small pebbles.

Permeability is slow in this Lagonda soil. Runoff is slow. The available water capacity is high. The organic matter content and natural fertility are high. The shrink-swell potential is high. The surface layer is friable, but it is tilled easily only within a moderate range of moisture content.

Most areas of this soil are farmed. The soil has good potential for cultivated crops, hay, and pasture. It has poor to fair potential for most engineering uses.

This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. There is a hazard of erosion if the soil is used continuously for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent damage from erosion. Many areas are suited to terracing and farming on the contour. Crop residue left on the surface and green manure crops can help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing reduces future production of grasses and legumes and increases weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This Lagonda soil has a moderate limitation for recreation uses because of wetness. This limitation can be overcome, however, by resurfacing areas subject to heavy foot traffic with fine gravel or other suitable material. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent damage to the structure from shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IIe-5.

LgC2—Lagonda silt loam, 5 to 9 percent slopes, eroded. This is a moderately sloping, somewhat poorly drained soil on the top and upper side slopes of ridges and on high benches. The areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is black silt loam about 7 inches thick. The subsoil is about 54 inches thick. In the upper part it is dark grayish brown and grayish brown, mottled, firm silty clay, and in the lower part it is yellowish brown, mottled, firm silty clay. The underlying material, to a depth of 72 inches, is strong brown and gray, firm clay loam. In some places the present surface layer is dark grayish brown silty clay loam because plowing has mixed the upper part of the subsoil with the original surface layer. Also, in a few places the surface layer is brown clay loam.

Permeability is slow in this Lagonda soil. Runoff is medium. The available water capacity is high. The organic matter content is moderate, and natural fertility is high. The shrink-swell potential is high. The surface layer is friable, but it is tilled easily only within a moderate range of moisture content.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops and good potential for hay and pasture. It has poor to fair potential for most engineering uses.

This soil is suited to corn and soybeans and is well suited to small grains and grasses and legumes for hay and pasture. There is a hazard of further serious erosion if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent damage from erosion. Most areas are suited to terracing and farming on the contour. Crop residue left on the surface and green manure crops can help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This Lagonda soil has moderate limitations for most recreation uses because of wetness. It has severe limitation for playgrounds because of the steepness of the slope. Play areas and walkways require resurfacing with fine gravel or other suitable material. Areas too steep for playgrounds could be leveled and then the topsoil replaced and reseeded. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent structural damage from the shrinking and swelling of the soil. Drainage tile can be used to

prevent damage from excessive wetness. Sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IIIe-5.

LhC3—Lagonda silty clay loam, 5 to 9 percent slopes, severely eroded. This is a moderately sloping, somewhat poorly drained soil on upper side slopes of ridges and on high benches. The areas are irregular in shape and range from 10 to 55 acres in size.

Typically, the surface layer is dark gray or very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 49 inches thick. In the upper part it is dark grayish brown, mottled, firm silty clay, and in the lower part it is yellowish brown, mottled, firm silty clay. The underlying material, to a depth of 67 inches, is strong brown and gray firm clay loam. In a few places, the surface layer is black silt loam. In several places it is brown clay loam.

Permeability is slow in this Lagonda soil. Runoff is rapid. The available water capacity is moderate. The organic matter content is low, and natural fertility is medium. The shrink-swell potential is high. The surface layer is sticky when wet, and it is difficult to till except under optimum moisture conditions.

Most areas of this soil are farmed. This soil has poor potential for cultivated crops and fair potential for hay and pasture. It has good potential for wildlife habitat development and poor to fair potential for most engineering uses.

This soil is suited to small grains and grasses and legumes for hay and pasture. There is a hazard of further serious erosion if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent damage from erosion. Most slopes are suited to terraces, but construction of the terraces exposes the upper part of the subsoil and the clayey texture of the subsoil makes tillage and management of the terraces and channels difficult. Proper management of crop residue helps control erosion, maintain the organic matter content and tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This Lagonda soil is suited to the development of habitat for openland and woodland wildlife. There are some limitations to establishing food plots because of slope and wetness. These limitations can be overcome by timely seeding and practices for controlling erosion.

This soil has moderate limitations for recreation uses because of wetness. It has severe limitations for playgrounds because of the steepness of the slope. Play areas and walkways require resurfacing with fine gravel or other suitable material. Areas too steep for playgrounds could be leveled and then the topsoil replaced and reseeded. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent structural damage from the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IVe-8.

LmC2—Lamoni clay loam, 5 to 9 percent slopes, eroded. This is a moderately sloping, somewhat poorly drained soil on upper side slopes of ridges. The areas are irregular in shape and range from 10 to over 100 acres in size.

Typically, the surface layer is black clay loam about 9 inches thick. The subsoil is about 35 inches thick. It is mainly dark yellowish brown, dark grayish brown and grayish brown, mottled, firm clay and strong brown clay loam. The underlying material, to a depth of 66 inches, is grayish brown and yellowish brown clay loam. In some places the present surface layer is brown clay loam because plowing has mixed the upper part of the subsoil with the original surface layer.

Included with this soil in mapping are several small areas of moderately well drained Shelby soils. These soils are on the lower steeper slopes and make up about 5 to 12 percent of this map unit.

Permeability is very slow in this Lamoni soil. Runoff is medium. The available water capacity is moderate. The organic matter content is moderate, and natural fertility is high. The shrink-swell potential of the subsoil is high. The surface layer is friable, but it is tilled easily only within a moderate range of moisture content.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops and good potential for hay and pasture. It has poor potential for most engineering uses.

This soil is suited to corn, soybeans, and well suited to small grains and grasses and legumes for hay and pasture. There is a hazard of further serious erosion if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways help prevent erosion. Most areas are suited to terracing and farming on the contour (fig. 6). Crop residue left on the surface and green manure crops help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This Lamoni soil has moderate to severe limitations for recreation uses because of wetness. Play areas and walkways require resurfacing with fine gravel or other suitable material. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be properly designed to prevent damage to the structure from shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface layer will have to be covered with base material if local roads and streets are to function properly. Capability unit IIIe-5.

LmC3—Lamoni clay loam, 5 to 9 percent slopes, severely eroded. This is a moderately sloping, somewhat poorly drained soil on shoulders of upper side slopes. The areas are irregular in shape and range from 10 to more than 50 acres in size.

Typically, the surface layer is brown clay loam about 7 inches thick. The subsoil is about 30 inches thick. In the upper part it is dark yellowish brown, mottled, firm clay; in the middle part it is dark grayish brown and grayish brown, mottled, firm clay; and in the lower part it is grayish brown and strong brown clay loam. The underlying material, to a depth of 60 inches, is grayish brown and yellowish brown clay loam. In a few places the surface layer is black clay loam.

Included with this soil in mapping are some areas of moderately well drained Shelby soils. These soils are on the lower steeper side slopes and make up about 5 to 12 percent of the map unit.

Permeability is very slow in this Lamoni soil. Runoff is rapid. The available water capacity is moderate. The organic matter content is low, and natural fertility is medium. The shrink-swell potential is high. The surface layer is sticky when wet, and it is difficult to till except under optimum moisture conditions.

Most areas of this soil are farmed. This soil has poor potential for cultivated crops and fair potential for hay and pasture. It has good potential for the development of habitat for openland wildlife and poor potential for most engineering uses.

This soil is suited to small grains and grasses and legumes for hay and pasture. There is a serious hazard of erosion if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent erosion. Most slopes are suited to terraces, but construction of the terraces exposes the upper part of the subsoil, and the clay texture of the subsoil makes tillage and management of the terraces and channels difficult. Crop residue left on the surface and green manure crops help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This Lamoni soil is suited to development of habitat for openland and woodland wildlife. There are some limitations to establishing food and cover plantings because of slope, surface texture, and wetness. These limitations can be overcome by timely seeding and practices for controlling erosion.

This soil has moderate to severe limitations for recreation uses because of wetness. Play areas and walkways require resurfacing with fine gravel or other suitable material. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent damage to the structure from shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to properly designed sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IVe-8.

No—Nodaway silt loam. This is a nearly level, moderately well drained soil on the flood plain of large streams, adjacent to the old stream channels (fig. 7). It is subject to occasional flooding. The areas are irregular in shape. They are 300 feet to about one-fourth mile wide and one-half mile to several miles long.

Typically, the surface layer is very dark grayish brown silt loam about 15 inches thick. The underlying material, to a depth of 75 inches, is very dark grayish brown silt loam; it has many thin layers of dark grayish brown silt loam or very fine sandy loam. In several places the surface layer is dark grayish brown loam or very fine sandy loam.

Included with this soil in mapping are poorly drained Humeston soils in several areas that are lower and more distant from the stream channel. Also included, in low lying, half-moon shaped areas in the meanders of stream channel, are soils that have a surface layer of loam or very fine sandy loam underlain by sand. These areas are 10 to 20 feet lower than the adjoining Nodaway soils and are flooded more frequently. Small sandy spots are shown on the map by a symbol for sand. Most of these spots are along the Thompson River in the northern part of the county; the areas are best suited to timber and wildlife habitat.

Permeability is moderate in this Nodaway soil. Runoff is slow. The available water capacity is high. The organic matter content and natural fertility are high. The surface layer is friable and is easily tilled within a wide range of moisture content.

Most areas of this soil are farmed. The soil has good potential for cultivated crops, hay, pasture, trees, and woodland wildlife habitat. It has poor potential for most engineering uses. It is a good source of topsoil and daily cover for landfill.

This soil is suited to corn, soybeans, small grains, and grasses and legumes. Occasional flooding is the only problem in using this soil for crops. Land smoothing can improve surface drainage, which is needed in a few places. Minimum tillage and crop residue management help maintain or improve the organic matter content, fertility, and soil tilth.

If this soil is used to grow hay, occasional flooding may cause some damage or loss of the crop. Alfalfa grows well if flooding is controlled.

This Nodaway soil is well suited to trees and food and cover plants for wildlife. There are no hazards or limitations for growing trees or establishing habitat for openland and woodland wildlife.

This soil has severe limitations for building sites because of occasional flooding. Dwellings or small buildings constructed on this soil must be protected from flooding. Capability unit IIw-4.

PeB—Pershing silt loam, 2 to 5 percent slopes. This is a gently sloping, somewhat poorly drained soil on the top and side slopes of narrow ridges. The areas are narrow and irregular in shape. They range from 10 to 50 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsoil is about 31 inches thick. In the upper part it is brown and dark yellowish brown, mottled, firm silty clay loam; in the middle part it is dark grayish brown, mottled, firm silty clay; and in the lower part it is grayish brown, mottled, firm silty clay loam. The underlying material, to a depth of 70 inches, is grayish brown and dark yellowish brown, mottled, silty clay loam. In several small places the surface layer is more than 10 inches thick.

Permeability is slow in this Pershing soil. Runoff is slow. The available water capacity is high. The organic matter content is moderate, and natural fertility is medium. The shrink-swell potential of the subsoil is high. The surface layer is friable, but it is tilled easily only within a moderate range of moisture content.

Most areas of this soil are farmed. The soil has good potential for cultivated crops and hay and pasture. It has poor to fair potential for most engineering uses.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. There is a hazard of erosion if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent damage from erosion. Most areas are suited to terracing and farming on the contour. Crop residue left on the surface and green manure crops help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This soil is suited to development of habitat for openland wildlife. There are no hazards or limitations to be concerned about in establishing food and cover plants for wildlife.

This Pershing soil has a moderate limitation for recreation uses because of wetness. This limitation can be overcome, however, by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent structural damage from the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if local roads and streets are to function properly. Capability unit IIIe-5.

PeC—Pershing silt loam, 5 to 9 percent slopes. This is a moderately sloping, somewhat poorly drained soil on the top and upper side slopes of narrow ridges. The areas are irregular in shape. They range from 10 to 60 acres in size.

Typically, the surface layer is very dark gray brown silt loam about 6 inches thick. The subsoil is about 36 inches thick. In the upper part it is dark grayish brown, mottled, firm silty clay loam and silty clay; in the lower part it is dark yellowish brown, mottled, firm silty clay loam. The underlying material, to a depth of 72 inches, is grayish brown, mottled silty clay loam. In several places the present surface layer is brown silty clay loam because plowing has mixed the upper part of the subsoil with the original surface layer. In several places the subsoil is more than 10 percent sand and has some small pebbles.

Included with this soil in mapping are moderately well drained Ladoga soils in a few small areas on lower slopes adjacent to Gasconade soils.

Permeability is slow in this Pershing soil. Runoff is medium. The available water capacity is high. The organic matter content is moderate, and natural fertility is medium. The shrink-swell potential of the subsoil is high. The surface layer is friable, but it is tilled easily only within a moderate range of moisture content.

Most areas of this soil are farmed. The soil has fair potential for cultivated crops and good potential for hay and pasture and for the development of wildlife habitat. It has poor to fair potential for most engineering uses.

This soil is suited to corn and soybeans and well suited to small grain and grasses and legumes for hay and pasture. There is a serious hazard of erosion if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent damage from erosion. Many areas are suited to terracing and farming on the contour. Proper management of crop residue and green manure crops can help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This soil is suited to development of habitat for openland and woodland wildlife. There are no hazards or limitations to be concerned about in establishing food and cover plants for wildlife.

This Pershing soil has a moderate limitation for most recreation uses because of wetness. This limitation can be overcome, however, by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material. Areas that are too steep for playgrounds can be leveled and then the topsoil replaced and reseeded. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed so that the structure is not damaged by the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to properly designed sewage lagoons or commercial sewers. The surface layer should be covered with base material if local roads and streets are to function properly. Capability unit IIIe-5.

PgC3—Pershing silty clay loam, 5 to 9 percent slopes, severely eroded. This is a moderately sloping, somewhat poorly drained soil on side slopes. The areas are irregular in shape and range from 7 to 25 acres in size.

Typically, the surface layer is brown silty clay loam about 6 inches thick. The subsoil is about 27 inches thick. In the upper part it is dark yellowish brown, mottled, firm silty clay loam; in the middle part it is dark grayish brown, mottled, firm silty clay; and in the lower part it is grayish brown, mottled, firm silty clay loam. The underlying material, to a depth of 65 inches, is mottled, grayish brown and dark yellowish brown silty clay loam. In a few places the surface layer is very dark brown silt loam, and in several places the surface layer and subsoil are more than 10 percent sand and contain some small pebbles.

Permeability is slow in this Pershing soil. Runoff is rapid. The available water capacity is high. The organic matter content and natural fertility are low. The surface layer is sticky when wet, and it is difficult to till except under optimum moisture conditions.

Most areas of this soil are used for hay and pasture. The soil has fair potential for small grain and for hay and pasture; it has fair potential for wildlife habitat and poor to fair potential for most engineering uses.

This soil is suited to grasses and legumes for hay and pasture. There is a serious hazard of erosion if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent damage from erosion. Some slopes are suited to terracing, but terracing exposes the subsoil, and the clayey texture of the subsoil makes tillage and management of the terraces and channels difficult. Proper management of crop residue can help control erosion, maintain the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This Pershing soil is suited to the development of habitat for openland and woodland wildlife. There are some limitations to be concerned about in establishing food and cover plants for wildlife because of the slope, the texture of the surface layer, and wetness. The limitations can be overcome, however, by timely seeding and by using erosion control practices.

This soil has a moderate limitation for most recreation uses because of wetness. This limitation can be overcome, however, by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material. Areas that are too steep for playgrounds can be leveled and then the topsoil replaced and reseeded. The limitations for building sites are severe. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed so that the structure is not damaged by the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to properly designed sewage lagoons or commercial sewers. The surface layer should be covered with base material if local roads and streets are to function properly. Capability unit IVe-8.

Pt—Pits, quarries. Pits and quarries consist of open excavations from which soil material has been removed to expose the underlying limestone bedrock. A few small pits are abandoned coal mines. Coal was removed out of the hillside, and the exposed area is covered with debris left from the loading and processing of the coal. One large area is a sand pit on the Thompson River northeast of Mt. Moriah. The sand is taken from sandbars along the channel of the river and processed and stockpiled on the adjoining bottom lands. There is one area of this map unit near Melbourne where the debris contained mostly soil material, and it was left smooth enough that the area could be used for pasture.

The typical quarry has a vertical face or exposure of the rock formation being mined. These exposures are 20 to 40 feet high. Above this vertical rock face the overburden of glacial-deposited material is 15 to 25 feet thick in most places. The overburden is removed and stockpiled on adjoining undisturbed areas or put back in previously mined pits.

Pits and quarries are not suitable for use as cropland or pasture because they have very little soil material or are

too steep. Weeds and brush grow on the stockpiled soil material. Many of the abandoned deep pits have no outlet for drainage and fill up with water. With proper reclamation most quarries have potential for use as wildlife habitat or for recreation uses.

ShD—Shelby loam, 9 to 14 percent slopes. This is a strongly sloping, moderately well drained soil on lower side slopes of narrow dissected ridges. The areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is black and very dark brown loam about 13 inches thick. The subsoil is about 21 inches thick. In the upper part it is dark yellowish brown clay loam, and in the lower part it is yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 72 inches, is yellowish brown, mottled, calcareous, firm clay loam. In many small places the surface layer is less than 10 inches thick. In a few places, erosion has removed most of the original surface layer, and the present surface layer is brown clay loam from the upper part of the subsoil.

Included with this soil in mapping are somewhat poorly drained Adair soils in several small areas on the upper part of slopes. The Adair soils make up 5 to 10 percent of this map unit.

Permeability is moderately slow in this Shelby soil. Runoff is medium. The available water capacity is high. The organic matter content and natural fertility are high. The shrink-swell potential is moderate. The surface layer is friable, and it is tilled easily within a fairly wide range of moisture content.

Most areas of this soil are farmed. The soil has fair potential for cultivated crops and good potential for hay and pasture. It has fair to poor potential for most engineering uses.

This soil is moderately well suited to corn and soybeans and well suited to small grain and grasses and legumes for hay and pasture. There is a severe hazard of erosion if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent erosion. Some areas are suited to terracing and farming on the contour. Proper management of crop residue and green manure crops can help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This Shelby soil has moderate to severe limitations for recreational development because of steep slopes and wetness. Slopes are too steep for playgrounds, but they cause only moderate problems for other uses. Areas that are too steep can be leveled and the runoff diverted. The topsoil should then be replaced and reseeded. Areas subject to heavy foot traffic can be resurfaced with fine gravel or other suitable material.

This soil has moderate limitations for building sites imposed mainly by the shrink-swell potential and slope. Basement walls, foundations, and footings for dwellings should be properly designed to prevent structural damage from the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. The areas are too steep for small commercial buildings. Sites need to be leveled if buildings are to be constructed on this soil, and runoff needs to be diverted. Sanitary facilities should be connected to commercial sewers or piped to adjacent areas that are suitable for lagoons. The surface layer needs to be covered with base material if roads and streets are to function properly. Capability unit IIIe-1.

ShE—Shelby loam, 14 to 20 percent slopes. This is a moderately steep, moderately well drained soil on the lower side slopes of valleys and narrow dissected ridges. The areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is black and very dark brown loam about 12 inches thick. The subsoil is about 18 inches thick. In the upper part it is dark brown and dark yellowish brown clay loam, and in the lower part it is yellowish brown, firm clay loam. The underlying material, to a depth of 66 inches, is yellowish brown, mottled, calcareous, firm clay loam. In many small places, the surface layer is less than 10 inches thick. In a few places, erosion has removed most of the original surface layer, and the present surface layer is brown clay loam from the upper part of the subsoil.

Permeability is moderately slow in this Shelby soil. Runoff is rapid. The available water capacity is high. The organic matter content and natural fertility are high. The shrink-swell potential is moderate. The surface layer is friable, and it is tilled easily within a fairly wide range of moisture content.

This soil has good potential for hay and pasture, and most areas are in hay or pasture. The soil has poor potential for most engineering uses.

This soil is poorly suited to cultivated crops because of steep slopes. There is a severe hazard of erosion if the soil is used for cultivated crops. If the soil is used for crops, minimum tillage on the contour, winter cover crops, and grassed waterways can help control erosion.

Reseeding pastures to more productive grasses and legumes generally requires some tillage in preparing a suitable seedbed. Tillage and seeding should be timely to insure a vegetative cover during winter.

Overgrazing is a problem in areas used for pasture and hay. It can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This soil has severe limitations for most recreational development and for building sites because of steepness of slope. Limitations for paths and trails are moderate because of the slope. If dwellings are built on this soil, they should be designed in a way that the shrinking and swelling of the soil does not damage the foundation and basement walls. Drainage tile can be used to prevent damage from excessive wetness. Provisions to prevent or divert rapid runoff should be made. The surface layer should be covered with base material if roads and streets are to function properly. Capability unit IVe-1.

SkD3—Shelby clay loam, 9 to 14 percent slopes, severely eroded. This is a strongly sloping, moderately well drained soil on lower side slopes of valleys and narrow dissected ridges. The areas are irregular in shape and range from 7 to more than 75 acres in size.

Typically, the surface layer is dark brown clay loam about 7 inches thick. The subsoil is about 18 inches thick. In the upper part it is dark yellowish brown clay loam, and in the lower part it is yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 58 inches, is yellowish brown, mottled, calcareous, firm clay loam. In several places the surface layer is black loam.

Included with this soil in mapping are somewhat poorly drained Adair soils in several small areas on the upper part of the slope. These areas make up about 5 to 10 percent of this map unit.

Permeability is moderately slow in this Shelby soil. Runoff is rapid. The available water capacity is high. The content of organic matter is low, and natural fertility is medium. The shrink-swell potential is moderate. The surface layer is sticky when wet, and it is difficult to till except under optimum moisture conditions.

Most of this soil has been farmed. The soil has poor potential for cultivated crops and fair potential for hay and pasture. It has good potential for the development of habitat for woodland wildlife. It has fair to poor potential for most engineering uses.

This soil is suited to grasses and legumes for hay and pasture. There is a severe hazard of erosion if the soil is used for cultivated crops. If this soil is used for crops, minimum tillage, winter cover crops, and grassed waterways can help prevent erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

In establishing or reseeding grasses and legumes, minimum tillage and timely seeding help insure a plant cover in winter. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction and excessive runoff. Small gullies in a few areas need to be reshaped and reseeded to grasses. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This Shelby soil is suited to the development of habitat for woodland wildlife. The slope imposes some limitations to the establishment of food and cover plants for wildlife. These limitations can be overcome by timely seeding and proper management to control erosion.

This soil has moderate to severe limitations for recreational development because of steep slopes and wetness. Some areas are too steep for playgrounds, but they can be leveled and runoff can be diverted. The topsoil should then be replaced and reseeded. Areas subject to heavy foot traffic can be resurfaced with fine gravel or other suitable material.

This soil has moderate limitations for building sites. The main problems are caused by the shrink-swell potential and slope. Basement walls, foundations, and footings for dwellings should be designed so that there is no structural damage from the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to commercial sewers or piped to adjacent areas that are suitable for lagoons. The surface layer should be covered with base material if roads and streets are to function properly. Capability unit IVe-4.

SkE3—Shelby clay loam, 14 to 20 percent slopes, severely eroded. This is a moderately steep, moderately well drained soil on the lower side slopes of narrow dissected ridges. The areas are irregular in shape and range from 7 to 50 acres or more in size.

Typically, the surface layer is dark brown clay loam about 6 inches thick. The subsoil is about 19 inches thick. In the upper part it is dark yellowish brown clay loam, and in the lower part it is yellowish brown, mottled, firm clay loam. The underlying material, to a depth of 60 inches, is yellowish brown, mottled, calcareous, firm clay loam. In several places the surface layer is black loam.

Permeability is moderately slow in this Shelby soil. Runoff is rapid. The available water capacity is high. The content of organic matter is low, and natural fertility is medium. The shrink-swell potential is moderate. The surface layer is sticky when wet, and tillage is difficult except under optimum moisture conditions.

This soil has fair potential for hay and pasture, and it is used mostly for hay and pasture. It has poor potential for most engineering uses.

This soil is poorly suited to cultivated crops because of steep slopes. The hazard of erosion is severe if the soil is used for cultivated crops. This soil is best suited to grasses and legumes for hay and pasture. Reseeding pastures to more productive grasses and legumes generally requires some tillage in preparing a suitable seedbed. Minimum tillage should be used and seeding should be timely to insure a vegetative cover during winter.

Overgrazing pastures can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This Shelby soil is suitable for the development of habitat for openland and woodland wildlife. There are some limitations to the establishment of food and cover plants for wildlife because of slope. These limitations can be overcome by timely seeding and proper practices to control erosion.

This soil has severe limitations for most recreation uses and for building sites because of steep slopes. For paths and trails, the limitations are only moderate. If dwellings are built on these soils, they should be designed in a way that the shrinking and swelling of the soil does not damage the foundation and basement walls. Drainage tile can be used to prevent damage from excessive wetness. Rapid runoff should be prevented or diverted. The surface should be covered with base material if roads and streets are to function properly. Capability unit VIe-4.

Wa—Wabash silty clay. This is a nearly level to depressional, very poorly drained soil on the flood plain of large streams. It is subject to occasional flooding. The areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is black silty clay about 18 inches thick. The subsoil is very dark gray and dark gray, firm silty clay about 50 inches thick. The underlying material, to a depth of 83 inches, is dark gray, firm silty clay. In several small areas and in a few large ones, the surface layer is black silty clay loam.

Permeability is very slow, and runoff is very slow. The available water capacity is moderate. The content of organic matter and natural fertility are high. The shrink-swell potential is very high. The surface layer is very sticky when wet and hard when dry. It is difficult to till even under optimum moisture conditions. If worked when wet, this Wabash soil gets very cloddy and difficult to manage.

Most areas of this soil are farmed (fig. 8). This soil has fair potential for cultivated crops and pasture. It has good potential for use as habitat for wetland wildlife. It has poor potential for most engineering uses.

This soil is suited to corn and soybeans. Occasional flooding and wetness caused by poor surface drainage are the main limitations. Surface drainage can be improved by land leveling and by shallow surface ditches. Crop residue left on the surface and deep tillage in the fall can help improve tilth and internal drainage and allow earlier seeding in spring.

Occasional flooding and wet areas are limitations if this soil is used for hay or pasture. Drainage can be improved in the wet areas by land smoothing and installing shallow ditches. Overgrazing or grazing when the soil is too wet causes surface compaction, poor tilth, and a reduction in the stand of grasses and legumes. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This soil is suited to the development of habitat for wetland wildlife. It has no limitations in establishing food and cover plants for wildlife.

This Wabash soil has severe limitations for recreation uses and for building sites because of occasional flooding, wetness, and a very high shrink-swell potential. If dwellings or small buildings are constructed on this soil, they need to be protected from flooding, and extreme precautions in design are necessary. Capability unit IIIw-14.

WeB—Weller silt loam, 2 to 5 percent slopes. This is a gently sloping, moderately well drained soil on the top of ridgelike areas on high benches adjacent to bottom lands. The areas are somewhat narrow and irregular in shape. They range from 5 to 40 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 56 inches thick. In the upper part it is brown, silty clay loam; in the middle part it is yellowish brown, mottled, firm silty clay; and in the lower part it is brown and grayish brown, mottled, firm silty clay loam. The underlying material, to a depth of 89 inches, is dark gray and dark grayish brown, mottled, silty clay loam. In a few places the surface layer is very dark grayish brown silt loam.

Included with this soil in mapping are a few large areas of a nearly level soil that has a surface layer that is about 17 inches thick and is gray in the lower part.

Permeability is slow and runoff is slow. The available water capacity is high. The organic matter content and natural fertility are low. The shrink-swell potential is high. The surface layer is friable, but it is tilled easily only within a moderate range of moisture content.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops and good potential for small grain, hay, pasture, trees, and wildlife habitat. It has poor to fair potential for most engineering uses.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. There is a hazard of erosion if this soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent erosion. Many areas are suited to terracing and farming on the contour. Crop residue left on the surface and green manure crops help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help keep the pasture and soil in good condition.

This soil is suited to trees and to development of habitat for openland and woodland wildlife. There are no hazards or limitations to be concerned about in planting or harvesting trees or establishing food and cover plants for wildlife.

This Weller soil has moderate limitations for recreation uses because of wetness. The wetness can be corrected, however, by resurfacing areas that are subject to heavy

foot traffic with fine gravel or other suitable material. This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be properly designed to prevent structural damage from the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to properly designed sewage lagoons or commercial sewers. The surface layer should be covered with base material if roads and streets are to function properly. Capability unit IIIe-5.

WeC—Weller silt loam, 5 to 9 percent slopes. This is a moderately sloping, moderately well drained soil on ridges and side slopes of high benches that are adjacent to bottom lands. The areas are irregular in shape. They range from 7 to 30 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 56 inches thick. In the upper part it is grayish brown, mottled, silty clay loam; in the middle part it is brown and grayish brown, mottled, firm silty clay; and in the lower part it is grayish brown, mottled, firm silty clay loam. The underlying material, to a depth of 75 inches, is dark gray and dark grayish brown, mottled, silty clay loam. In a few places, the present surface layer is brown silty clay loam because plowing has mixed the upper part of the subsoil with the original surface layer. In several places the subsoil is more than 10 percent sand and contains some small pebbles.

Permeability is slow, and runoff is medium. The available water capacity is high. The organic matter content and natural fertility are low. The shrink-swell potential is high. The surface layer is friable, but it is tilled easily only within a moderate range of moisture conditions.

Most areas of this soil are farmed. The soil has fair potential for cultivated crops and small grain. It has good potential for hay, pasture, trees, and wildlife habitat. It has poor potential for most engineering uses.

This soil is moderately suited to corn, soybeans, and small grain and well suited to grasses and legumes for hay and pasture. The hazard of erosion is severe if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent damage from erosion. Many areas are suited to terracing and farming on the contour. Proper management of crop residues and green manure crops can help control erosion, maintain or increase the organic matter content, improve tilth, and increase water infiltration.

The use of this soil for pasture or hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help maintain the pasture and soil in good condition.

This Weller soil is suited to trees and to the development of habitat for openland and woodland wildlife. There are no limitations to planting or harvesting trees. There are some hazards in establishing food and cover plants for wildlife because of slope. The limitations can be overcome by timely seeding and proper practices that control erosion.

This soil has moderate limitations for most recreation uses because of wetness. Also, slopes are extremely steep for playgrounds. The wetness can be corrected by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material. Areas that are too steep for playgrounds can be leveled and then the topsoil should be replaced and reseeded.

This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be designed to prevent structural damage by the shrinking and swelling of the soil. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface layer needs to be covered with base material if roads and streets are to function properly. Capability unit IIIe-5.

WgC3—Weller silty clay loam, 5 to 9 percent slopes, severely eroded. This is a moderately well drained soil on side slopes of high benches adjacent to bottom lands. The areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is brown or grayish brown silty clay loam about 8 inches thick. The subsoil is about 50 inches thick. It is yellowish brown, mottled, firm silty clay; and brown and grayish brown, mottled, firm silty clay loam. The underlying material, to a depth of 83 inches, is dark gray and grayish brown, mottled silty clay loam. In a few places, the surface layer is dark grayish brown silt loam. In several places the subsoil is more than 10 percent sand and has some small pebbles.

Permeability is slow in this Weller soil. Runoff is rapid. The available water capacity is high. The organic matter content and natural fertility are low. The shrink-swell potential is high. The surface layer is sticky when wet, and it is tilled easily only under optimum moisture conditions.

Most areas of this soil are used for pasture or hay. A few areas are used for cultivated crops. The soil has poor potential for cultivated crops and small grain and fair potential for hay, pasture, and wildlife habitat. It has good potential for trees. It has poor potential for most engineering uses.

This soil is suited to grasses and legumes for hay and pasture. The hazard of erosion is serious if the soil is used for cultivated crops. Minimum tillage, winter cover crops, and grassed waterways can help prevent erosion. Some slopes are suited to terracing, but terracing exposes the subsoil, and the clayey texture of the subsoil makes tillage and management of the terraces and channels difficult. Proper management of crop residue helps control erosion, maintain the organic matter content, improve tilth, and increase water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling erosion. Overgrazing can reduce future production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This Weller soil is suited to trees, and there are no hazards or limitations to the planting or harvesting of trees. There are some limitations to the establishment of food and cover plants for wildlife because of slope. The limitations can be overcome by timely seeding and practices that control erosion.

This soil has moderate limitations for most recreational uses because of wetness. Furthermore, the slopes are too steep for playgrounds. The wetness can be corrected by resurfacing areas that are subject to heavy foot traffic with fine gravel or other suitable material. Areas too steep for playgrounds can be leveled, and then the topsoil should be replaced and reseeded.

This soil has severe limitations for building sites. Basement walls, foundations, and footings for dwellings and small commercial buildings should be properly designed so that the shrinking and swelling of the soil does not cause structural damage. Drainage tile can be used to prevent damage from excessive wetness. Sanitary facilities should be connected to sewage lagoons or commercial sewers. The surface layer should be covered with base material if roads and streets are to function properly. Capability unit IVe-8.

Zo—Zook silty clay loam. This is a nearly level, poorly drained soil on the flood plain of small and large streams. It is subject to occasional flooding. The areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is about 37 inches thick. In the upper part it is black and very dark gray silty clay loam, and in the lower part it is very dark gray silty clay. The subsoil is dark gray, silty clay about 29 inches thick. The underlying material, to a depth of 85 inches, is dark gray silty clay. In several small areas, the plow layer is black silt loam.

Included with this soil in mapping are poorly drained Humeston soils in a few areas that are closer to the stream channels. Humeston soils have a surface layer of silt loam. They make up 5 to 10 percent of this map unit.

Permeability is slow in this Zook soil. Runoff is very slow. The available water capacity is moderate. The organic matter content and natural fertility are high. The shrink-swell potential is high. The surface layer is sticky when wet, and it is tilled easily only under optimum moisture conditions. This soil gets cloddy and is difficult to manage if worked when wet.

Most areas of this soil are farmed. The soil has good potential for cultivated crops and as habitat for wetland wildlife and fair potential for hay and pasture. It has poor potential for most engineering uses.

This soil is suited to corn and soybeans. Occasional flooding and wetness because of poor surface drainage are the main problems. But poor surface drainage can be corrected by land smoothing and surface ditches. Crop residue left on the surface and deep tillage in the fall help improve tilth and internal drainage and allow earlier seeding in spring.

Occasional flooding and wet areas are a problem if these soils are used for hay or pasture. Land smoothing and shallow ditches can help overcome these limitations. Overgrazing or grazing when the soil is too wet causes surface compaction, poor tilth, and a reduction in the stand of grasses and legumes. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods can help maintain the pasture and soil in good condition.

This Zook soil is suited to the development of habitat for wetland wildlife. There are no hazards or limitations to be concerned about in establishing food and cover plants for wildlife. Shallow-water areas can be constructed easily.

This soil has severe limitations for recreation uses and for building sites because of occasional flooding, wetness, and the high shrink-swell potential of the soil. If dwellings and small buildings are constructed, they need protection from flooding, and extreme precautions in design are necessary. Capability unit IIw-2.

Zz—Zook-Colo silty clay loams, channeled. These are nearly level to undulating, poorly drained soils on narrow bottom lands. They are subject to occasional flooding. The areas are adjacent to the small drainageways that dissect the sloping uplands. Individual areas are long, narrow, and irregular in shape and range from 200 to 1,000 feet in width and from 700 feet to more than a mile in length. These soils have slopes as great as 3 percent from the base of the uplands to the streambanks and slopes of 1 to 3 percent from the head of the drainageways to their outlet.

Zook soils make up about 40 to 70 percent of the map unit and Colo soils 20 to 45 percent. Colo soils are at the head of the narrower drainageways and in convex, slightly mounded areas and on gentle slopes adjacent to the uplands. Zook soils are in the wider, nearly level to slightly concave lower areas of the narrow bottom lands. These two soils occur together in areas that are too small, irregular, narrow, and intermingled to be separated in mapping.

Typically, the Zook soil has a surface layer about 48 inches thick. The upper part is black, friable silty clay loam and the lower part is black, firm silty clay loam. The subsoil is very dark gray, firm, silty clay loam about 15 inches thick. The underlying material, to a depth of 72 inches, is dark gray, firm silty clay loam.

Typically, the Colo soil has a black silty clay loam surface layer about 46 inches thick. The underlying material, to a depth of 61 inches, is very dark gray firm silty clay loam. In some places the surface layer is black silt loam or loam. In a few other places it is dark grayish brown silt loam.

Included in mapping and making up 5 to 10 percent of this map unit are moderately well drained Nodaway soils in areas adjacent to the stream channel. Also included are small areas of recent deposits of brown, dark grayish brown, very dark grayish brown stratified silt loam and loam. This material is about 10 to 30 inches thick and is underlain by black heavy silty clay loam.

The Zook soil has slow permeability, and runoff is very slow. The Colo soil has moderately slow permeability, and runoff is slow. The available water capacity, the content of organic matter and natural fertility are high in both soils, and the shrink-swell potential is high.

The surface of the Zook soil stays wet longer than that of the Colo soil. The surface layer is sticky when wet and is easily tilled only under optimum moisture conditions. The Zook soil gets cloddy and is difficult to manage if worked when wet.

The Colo soil dries out quicker than the Zook soil, and it has better surface drainage because of its slighty mounded and gently sloping relief. The Colo soil is easily tilled within a wider range of moisture conditions.

Most areas of these soils are used for hay and pasture. A few areas are used for cultivated crops. These soils have poor potential for cultivated crops. In most areas they have fair potential for hay and pasture and for use as habitat for wetland wildlife. Production of grasses is good during droughty periods. The potential for most engineering uses is poor.

Corn and soybeans are the main crops in areas that can be cultivated. Grasses and legumes are grown for pasture and hay. Many long and narrow areas are inaccessible to large machinery. Many areas are highly dissected by gullies that stem from upland drainageways and by the meanders of intermittent streams. Most areas need surface drainage, especially the low lying wet spots. Ditchbank erosion and hill water are problems. Landgrading can help improve surface drainage, and diversions can help protect the areas from excess runoff from the adjacent uplands. Crop residue left on the surface helps improve tilth and internal drainage.

Hill water and wet areas are problems that affect the growth of grasses and legumes. Depressional areas hold water for long periods in the rainy seasons; thus, stands of legumes and of some grasses are reduced. Overgrazing can reduce production of grasses and legumes and increase weed growth. Grazing when the soil is too wet causes surface compaction and poor tilth, and it reduces stands of grasses and legumes.

These soils are suitable for uses as habitat for wetland wildlife. There are no limitations to be concerned about in establishing food and cover plants for wetland wildlife.

Zook and Colo soils have severe limitations for recreation uses and for building sites because of wetness and the high shrink-swell potential. Occasional flash flooding is a problem in the larger drainageways. Many structures are built on these soils. Nevertheless, dwellings and small buildings need protection from flooding, and extreme precautions in design are necessary. Most of the fill material should be secured from the nearby uplands. **Capability unit Vw-2.**

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

More than 382,918 acres in the survey area was cropland and pasture in 1967 (*3*). Of this total, 174,950 acres was used for permanent pasture; 92,283 for row

crops, mainly corn and soybeans; 6,601 acres for close-grown crops, mainly wheat and oats; and 70,576 acres for rotation hay and pasture. The rest was mostly land in conservation use and idle cropland.

Highway construction and urban development have taken very few acres of cropland out of production in the last 10 years.

The potential of the soils in Harrison County is good for sustained production of food. The 1967 Conservation Needs Inventory, however, showed that only about 36 percent of the cropland in the county was adequately treated to meet conservation needs (*3*). Cropland that is not adequately treated is more likely to be on the uplands where farming operations cause erosion in excess of what is considered tolerable to sustain production over a long period of time. Some of the marginal cropland used for row crops should be converted to pasture and hayland. Soil erosion on most of the cropland can be held to a tolerable amount by using a system of conservation practices to fit the soil.

Soil erosion is the major problem on about three-fourths of the cropland and pasture in Harrison County. If the slope is more than 2 percent, erosion is a hazard. Adair, Armstrong, Grundy, Lagonda, Lamoni, and Pershing soils have slopes of more than 2 percent. Furthermore, wetness is a limitation of these soils for some crops and for nonfarm uses.

Loss of the surface layer through erosion reduces the productivity of the soil. Loss of the surface layer is especially damaging if clayey subsoil material is incorporated into the plow layer. Adair, Armstrong, Grundy, Lagonda, Lamoni, and Pershing soils have a clayey subsoil. Erosion also reduces the productivity of those soils, such as Gasconade soils, that tend to be droughty because they are shallow to bedrock.

On many sloping soils, clayey spots where the original friable surface layer has been eroded away make preparing a good seedbed and tilling difficult. Such spots are common on the moderately eroded Adair, Lagonda, and Lamoni soils and to a lesser extent on uneroded Gara and Shelby soils. In 50 to 90 percent of the areas of the severely eroded Gara, Lagonda, Lamoni, Pershing, Shelby, and Weller soils, clayey subsoil material is at the surface.

Erosion control practices provide a protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps plant cover on the soil for extended periods reduces erosion and preserves the productive capacity of the soils. On livestock farms, the legumes and grass forage crops in the cropping system help reduce erosion on sloping land, provide nitrogen, and improve tilth for the crop that follows.

Slopes are too steep for terracing in most areas of the strongly sloping Gara and Shelby soils. On those soils if minimum tillage is not practiced, a cropping system that provides substantial vegetative cover is needed to help control erosion. Slopes are too steep for cultivated crops on the moderately steep Gara and Shelby soils. These soils should be in continuous vegetative cover. Minimum tillage and crop residue left on the surface help to increase infiltration and reduce the hazards of runoff and erosion (fig. 9). These practices can be adapted to many of the soils in the survey area, but they are more difficult to use successfully on the severely eroded soils that have a clayey surface layer. No tillage for corn is effective in reducing erosion on sloping land and can be adapted to many soils in the survey area. It is more difficult to practice successfully, however, on soils that have a clayey surface layer.

Terraces and diversions reduce the length of the slope and thereby help control runoff and erosion. They are most practical to use on uneroded soils that have regular slopes. Adair, Grundy, Ladoga, Lagonda, and Pershing soils and some Armstrong, Gara, Lamoni, Shelby, and Weller soils are suitable for terraces. Soils that are less suitable or not suitable are those that have irregular or steep slopes or a clayey subsoil that would be exposed in the terrace channels.

Contouring and contour stripcropping are effective erosion control practices in the survey area. The soils best suited to these practices are those that have smooth, uniform slopes, for example, most of the Grundy and Lagonda soils and many of the Adair, Armstrong, Gara, Ladoga, Lamoni, Pershing, Shelby, and Weller soils.

Soil drainage and flood control are the major concerns of management on about one-fourth of the acreage that is used for crops and pasture in the survey area. Some soils, Wabash and Zook soils for example, are naturally so wet that crops common to the area are damaged during most years. Somewhat less wet are the Colo, Haig, and Humeston soils. Surface drainage is needed to some extent on all of these soils. Flooding is the major hazard on the Nodaway soils.

Surface drainage is needed in most areas of the poorly drained and very poorly drained soils used for crops. The design of surface drainage systems varies with the kind of soil. Landgrading on the Wabash and Zook soils gives much better results than surface ditches. Haig soils also are suited to landgrading.

Tile drainage has not been used in the survey area, but possibly it can be used on the less clayey Colo and Humeston soils. Finding adequate outlets for surface drainage systems is difficult in some areas of Wabash soils.

Soil fertility is naturally low in most of the severely eroded soils in the survey area, and all soils need additional plant nutrients for maximum production. Most all soils in the survey area are naturally acid in the upper part of the root zone, and they need applications of ground limestone to raise the pH level sufficiently for good growth of legumes. On all soils, application of lime and fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields.

Soil tilth is an important factor in the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous.

Most of the uneroded soils on the uplands that are used for crops have a surface layer that is silt loam or loam, is dark in color, and has a medium to high content of organic matter. Generally, the structure of silt loam soils becomes weaker if overtilled and compacted. Intense rainfall causes the surface to crust. The crust is hard when dry and reduces water infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material help to improve soil structure and tilth.

All of the severely eroded soils on the uplands have a clayey surface layer that has poor tilth. The infiltration rate is slow, and runoff is rapid. These soils need permanent vegetative cover.

Most of the cropland on the uplands is on sloping soils that are subject to damaging erosion if they are plowed in the fall.

The Wabash and Zook soils are clayey, and tilth is a problem because the soils often stay wet until late in spring. If they are plowed when wet, they tend to be very cloddy when they dry, and seedbeds are difficult to prepare. Fall plowing generally results in better tilth in the spring.

Field crops suited to the soils and climate of the survey area and most commonly grown are corn and soybeans. Grain sorghum is grown on a few acres.

Wheat and oats are the common close-growing crops. Rye can be grown and grass seed can be produced from bromegrass, fescue, and orchardgrass.

Pasture and hay crops that are suited to the soils and climate of the survey area include several legumes, cool season grasses, and warm season native grasses. Alfalfa and red clover are the common legumes grown for hay. They are also used in mixtures that include bromegrass, orchardgrass, or timothy for hay and pasture. Birdsfoot trefoil is used in mixtures that include bromegrass, orchardgrass, fescue, and bluegrass for pasture.

Warm season native grasses adapted to the survey area are big bluestem, Indiangrass, and switchgrass. These grasses produce well during summer, but special management is needed to establish them and for proper grazing.

Deep, moderately well drained soils—for example, Gara, Nodaway, Weller, and Shelby soils—are well suited to alfalfa. Other legumes and all grasses do well on most of the soils on the uplands in the survey area. Because Humeston, Wabash, and Zook soils are flooded occasionally and stay wet for long periods, they are not suited to all grasses. They are better suited to short season summer annuals.

The major management concern on most of the pasture is overgrazing and gully erosion. Grazing should be controlled to protect plants so that they give maximum production. Grasses kept at a desirable height will reduce runoff and help control gully erosion.

Special crops such as vegetables and fruits are not commercially grown in the survey area.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the soil is not suited to the crop or the crop is not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 5.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticul-

tural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

There are no class I or class VIII soils in Harrison County.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is indicated in table 6. All soils in the survey area except those named at a level higher than the series are included. Some of the soils that are well suited to crops and pasture may be in low-intensity use, for example, soils in capability classes I and II. Data in this table can be used to determine the farming potential of such soils.

The capability unit is identified in the description of each soil map unit in the section "Soil maps for detailed planning." Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-5 or IVe-8.

Woodland management and productivity

This section was written by GARY R. NORDSTROM, forester, Soil Conservation Service.

In 1972 about 45,100 acres, or 10 percent of the county, was used for growing trees (*2*). There are several Christmas tree plantations, and a few plantations of Eastern white pine have been successfully established. The wooded tracts are owned by private individuals and are relatively small.

Timber production, recreation, and wildlife habitat are the main uses of the woodland.

The Gara-Pershing-Armstrong map unit has the largest percentage of woodland. The main forest type is upland oak; white oak, northern red oak, hickory, and black oak grow on narrow ridgetops and steep hillsides.

The Shelby-Adair-Zook, Grundy-Lagonda, and Lamoni-Shelby-Zook map units have only small areas in trees. Upland oak and elm-ash-cottonwood, the main forest types, grow in draws and along watercourses.

The Nodaway-Zook map unit is suited to bottom-land hardwoods of eastern cottonwood, pin oak, American sycamore, silver maple, and boxelder. Black walnut on the Nodaway soils has the potential of producing high quality walnut logs.

The potential of the soils for upland hardwoods is moderate to moderately high, except for Gasconade soils. Their potential is low. The potential of the soils for bottom-land hardwoods is high.

The following soils were not rated for woodland use and management because they are used mainly for crops and pasture: Adair, Colo, Grundy, Haig, Humeston, Lagonda, Lamoni, Shelby, and Zook soils. Several of these soils are well suited to wood crops, but technical assistance generally is needed in planning for that use on these soils.

Table 7 contains information useful to woodland owners or forest managers planning use of the soils for wood crops. Only those soils suitable for wood crops are listed, and the ordination (woodland suitability) symbol for each soil is given. All soils bearing the same ordination symbol require the same general kinds of woodland management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity;

2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates insignificant limitations or restrictions. If a soil has more than one limitation, priority in placing the soil into a limitation class is in the following order: x, w, t, d, c, s, f, and r.

In table 7 the soils are also rated for a number of factors to be considered in management. *Slight*, *moderate*, and *severe* are used to indicate the degree of major soil limitations.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if some measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Management implications: Careful design and construction of roads, skid trails, and fire lanes are needed to minimize the percent of slope, length of slope, and concentration of water. Erosion control measures may be necessary. These include ditches, culverts, outslope road surface, waterbreaks, and seeding disturbed areas to grass. The use of crawler and rubber-tired tractors on steep side slopes should be discontinued. Special operations such as yarding logs uphill with cable may be required.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or equipment; *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Management implications: Rubber-tired equipment should be used instead of crawler type tractors to reduce compaction in wet areas. For soils of subclass w, the use of equipment for management operations should be timed to seasons of the year when the soil is relatively dry.

Special operations such as yarding logs uphill with cable may be required to minimize the use of rubber-tired and crawler type tractors on steep slopes. Trees should be hand planted on soils of subclass d to reduce damage to planting equipment.

Seedling mortality ratings indicate the degree that the soil affects expected mortality of planted tree seedlings. Plant competition is not considered in the ratings. Seedlings from good planting stock that are properly planted during a period of sufficient rainfall are rated. A rating of *slight* indicates that the expected mortality of the planted seedlings is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Management implications: The use of special planting stock of larger size than usual or containerized stock may be necessary to achieve better survival. The possibility of the need for reinforcement planting must be recognized.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade or grow if openings are made in the tree canopy. The invading plants compete with native plants or planted seedlings by impeding or preventing their growth. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* means that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed for the control of undesirable plants.

Management implications: A moderate or severe rating indicates the need for careful and thorough site preparation by mechanical chemical means or both. The need for release treatments may be essential to insure development of the new crop.

The *potential productivity* of merchantable or *important trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. The site index for upland oak species is the height reached in 50 years (*10*). The site index for eastern cottonwood is the height reached in 30 years (*1*).

Trees to plant are those that are suitable for commercial wood production and that are suited to the soils.

Windbreaks and environmental plantings

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broad-leaved and coniferous species provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field, the interval depending on erodibility of the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. A healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table 8 shows the height that locally grown trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 8, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning

windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from nurserymen.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational areas; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 9 shows, for each kind of soil, the degree and kind of limitations for building site development; table 10, for sanitary facilities. Table 12 shows the kind of limitations for water management. Table 11 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 9. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 9 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 9 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 10 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight,* soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate,* soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe,* soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good, fair,* and *poor,* which mean about the same as *slight, moderate,* and *severe.*

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. Where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in ex-

cavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 10 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

If it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 11 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 15 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low frost action potential, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 11 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 15.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can restrict plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils or very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 12 the soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

This section was written by EDWARD A. GASKINS, biologist, Soil Conservation Service.

According to the Statewide Comprehensive Outdoor Recreation Plan (SCORP), Harrison County has 7,565 acres that are used for recreation (*5*). The areas used for recreation include 116 acres for playfields, 1,321 acres for fishing, 924 acres for boating, 264 acres for canoeing, 94,720 square feet for swimming, 23 acres for campgrounds, 53 acres for picnicking, and 100 acres for winter sports (fig. 10). State owned lands, which are open to the public, are at a minimum. The only wildlife area in Harrison County is 1,343-acre Wayne Helton Memorial Wildlife Area near Mt. Moriah.

The Nationwide Outdoor Recreation Inventory of the National Association of Conservation Districts list six private recreation enterprises that operate within the county (*6*). These enterprises include a campground and a racetrack.

The soils of the survey area are rated in table 13 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 13 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 10, and interpretations for dwellings without basements and for local roads and streets, given in table 9.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facili-

ties and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Wildlife habitat

This section was written by EDWARD A. GASKINS, biologist, Soil Conservation Service.

The rolling topography of Harrison County is typical of its past prairie history. Originally, 60 to 70 percent of the county was prairie and the rest was woodland (*7*). Today, the county is about 10 percent woodland, less than 1 percent original prairie, and the rest is cultivated land and pasture.

Openland wildlife is relatively stable and evenly distributed in the county. Woodland wildlife is declining and becoming more concentrated as more and more forested areas are converted to other uses.

The Shelby-Adair-Zook, Grundy-Lagonda, and Lamoni-Shelby-Zook map units make up about 67 percent of the county and provide most of the habitat suitable for openland wildlife (fig. 11). These map units support a medium to high population of rabbit, quail, and dove. Squirrel populations range from medium to low in wooded tracts, the fox squirrel predominating over the gray squirrel. Turkeys are rare in these areas because sizable tracts of hardwood timber are limited. Deer are declining as more and more wooded and brushy areas are converted to pastureland.

The Gara-Pershing-Armstrong map unit makes up about 20 percent of the land area and provides the major habitat for woodland wildlife. Forested tracts in this association have a medium population of deer and squirrel and a very low population of turkey. The numbers of openland species such as quail, rabbit, and dove depend on the acreage of cropland, hayland, and pastureland. The conversion of woodland to other land uses is reducing the base for species requiring a wooded habitat.

The Nodaway-Zook map unit makes up about 13 percent of the land area and is characterized by medium and large flood plains, which offer limited habitat for wetland wildlife. Waterfowl populations are very low in Harrison County because most of the area has had some form of drainage, and most areas are used for cultivated crops. A few swampy areas remain in pasture and woodland. The potential to develop habitat for wetland wildlife is best in this map unit.

Stream fishing in the county is limited to Big Creek and its major forks and the Thompson River in the eastern part of the county. The main sport fish in streams are channel and flathead catfish, red horse sucker, smallmouth and largemouth bass, carp, freshwater drum, and green sunfish. Spotted bass have been stocked in Big Creek.

Lake fishing is restricted to the 70-acre Bethany water-supply lake and the impoundments that were created by two Public Law 566 watershed projects. In the Big Creek Watershed Project area, a floodwater impoundment holds 40 acres of surface water and 7 grade stabilization structures hold about 45 acres. The Panther Creek Watershed Project consists of 6 floodwater impoundments totaling about 160 acres of surface water and 7 grade stabilization structures holding 60 acres of water. Numerous farm ponds scattered throughout the county provide additional fishing. Ponds and lakes generally are stocked with largemouth bass, channel catfish, and bluegill.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 14, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of

wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of habitat are very severe and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of hardwood plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, and cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail rabbit, and red fox.

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and

gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features.

Engineering properties

Table 15 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 15 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 15 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, without group index numbers, is given in table 15. Also in table 15 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and in plasticity index is estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

Physical and chemical properties

Table 16 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning

and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 16. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 17 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey (*12*) has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of

factors that affect soil genesis. In table 18, the soils of the survey area are classified according to the system. Categories of the system are described in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid climate, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Argiudolls (*Arg*, meaning clay accumulation, plus *udoll*, the suborder of Mollisols that have an argillic horizon).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceeding the name of the great group. The adjective *Typic* identifies the subgroup that is thought to typify the great group. An example is Typic Argiudolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, mesic, Typic Argiudolls.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*11*). Unless otherwise noted, colors described are for moist soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Adair series

The Adair series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in weathered glacial till and glacial sediment. Slopes range from 3 to 9 percent.

Adair soils in Harrison County have a thinner solum, fewer red mottles in the upper part of the B horizon and higher pH in the lower part of the B horizon than is defined as the range for the series, but these differences do not alter the use and management of the soils. Also, the eroded phase has a thinner surface layer.

Adair soils are similar to Shelby soils and are commonly adjacent to Shelby, Zook, and Colo soils on the landscape. Shelby soils are moderately well drained and do not have red mottles in the B horizon. They are on steeper slopes below Adair soils. Zook and Colo soils are poorly drained. They are on the small drainageways adjacent to Adair soils.

Typical pedon in an area of Adair loam, 3 to 9 percent slopes, in a field of red clover 1,320 feet south and 330 feet east of the NW corner of sec. 35, T. 63 N., R. 29 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam; weak fine and very fine granular structure; friable; many fine and very fine roots; slightly acid; clear smooth boundary.

A3—8 to 12 inches; very dark grayish brown (10YR 3/2) light clay loam, weak very fine subangular blocky structure; friable; many fine and very fine roots; medium acid; clear smooth boundary.

IIB21t—12 to 17 inches; dark grayish brown (10YR 4/2) clay loam; common fine prominent red (2.5YR 4/8) mottles and few fine distinct dark brown (7.5YR 4/4) mottles; moderate very fine subangular blocky structure; firm; common very fine roots; few thin clay films on faces of peds; few fine pebbles; slightly acid; clear smooth boundary.

IIB22t—17 to 21 inches; dark brown (7.5YR 4/4) light clay; common fine prominent red (2.5YR 4/6) mottles and few fine faint dark grayish brown mottles; moderate fine subangular blocky structure; firm; common very fine roots; few thin clay films on faces of peds; few fine pebbles; slightly acid; clear smooth boundary.

IIB23t—21 to 26 inches; yellowish brown (10YR 5/4) light clay; few fine prominent yellowish red (5YR 4/6) mottles and few fine distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; few very fine roots; few thin clay films on faces of peds; few fine pebbles; slightly acid; gradual smooth boundary.

IIB3—26 to 36 inches; yellowish brown (10YR 5/6) heavy clay loam; common fine faint dark yellowish brown (10YR 4/4) mottles; weak fine prismatic structure; firm; few very fine roots; few fine pebbles; neutral; clear smooth boundary.

IIC1—36 to 49 inches; yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) clay loam; weak fine prismatic structure; firm; few fine pebbles; few soft calcium masses; strong effervescence; mildly alkaline; gradual smooth boundary.

IIC2—49 to 73 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent grayish brown (2.5Y 5/2) mottles; massive; firm; few fine pebbles; many soft calcium masses; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 48 inches, but in most places the range is 30 to 40 inches. The mollic epipedon is 10 to 16 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly loam or clay loam but the range includes silty clay loam. The upper part of the B horizon dominantly is 10YR 4/4 or 7.5YR 4/4 in color but ranges from 10YR 4/2 to 5YR 4/6. The lower part of the B horizon ranges from 10YR 4/4 to 5/6 and has mottles of grayish brown to dark yellowish brown. The B horizon ranges from medium acid to neutral. The C horizon ranges in color from 10YR 5/6 to 2.5Y 5/2 but is dominantly 10YR 5/4 to 5/6.

Armstrong series

The Armstrong series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in weathered glacial till. Slopes range from 5 to 14 percent.

Armstrong soils in Harrison County have a thinner solum and higher pH in the lower part of the B horizon than is defined as the range for the series, but these differences do not seriously alter the use and behavior of the soil. Also, the severely eroded phase has a thinner surface layer.

Armstrong soils are similar to Pershing and Gara soils and are commonly adjacent to Gara and Pershing soils on the landscape. Gara soils are moderately well drained and do not have red and gray mottles in the upper part of the B horizon. They are on steeper side slopes below the Armstrong soils. Pershing soils formed in loess on side slopes above the Armstrong soils. They have a silty A horizon and do not have sand and glacial pebbles, which are common in Armstrong soils.

Typical pedon in an area of Armstrong loam, 5 to 9 percent slopes, in a pasture 1,320 feet south and 60 feet east of the center of sec. 36, T. 65 N., R. 28 W.

Ap—0 to 6 inches; black (10YR 2/1) loam; moderate fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

B1—6 to 11 inches; brown (10YR 4/3) light clay loam, very dark grayish brown (10YR 3/2) in small vertical cracks; few fine faint yellowish brown mottles; moderate very fine subangular blocky structure; firm; common fine roots; medium acid; clear smooth boundary.

IIB21t—11 to 16 inches; dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/8) clay loam; common fine distinct red (2.5YR 4/8) mottles; moderate fine subangular blocky structure; firm; few very fine roots; few thin clay films on faces of peds; few fine pebbles; strongly acid; gradual smooth boundary.

IIB22t—16 to 22 inches; dark grayish brown (10YR 4/2) clay; common fine distinct yellowish brown (10YR 5/8) mottles and few fine prominent red (2.5YR 4/8) mottles; moderate fine subangular blocky structure; firm; few very fine roots; few moderately thick clay films on faces of peds; few fine pebbles; strongly acid; gradual smooth boundary.

IIB3t—22 to 32 inches; yellowish brown (10YR 5/4) light clay; common fine distinct grayish brown (10YR 5/2) mottles; weak fine prismatic structure; firm; few thin clay films on faces of peds; few fine pebbles; neutral; gradual smooth boundary.

IIC1—32 to 37 inches; yellowish brown (10YR 5/6) heavy clay loam; common fine distinct light brownish gray (10YR 6/2) mottles; weak fine prismatic structure; firm; few soft calcium masses; mild effervescence near calcium masses; few fine pebbles; mildly alkaline; gradual smooth boundary.

IIC2—37 to 60 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) clay loam; few medium distinct strong brown (7.5YR 5/8) mottles; massive; firm; few fine pebbles; few small calcium masses; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 50 inches, but in most places the range is 30 to 42 inches.

The A1 or Ap horizon is black or very dark grayish brown loam, clay loam, or silt loam 6 to 8 inches thick. In some places there is an A2 horizon 1 inch to 3 inches thick. The B2 horizon ranges from 10YR 4/2 to 7.5YR 5/6 in color. The C horizon ranges from 2.5Y 5/2 to 7.5YR 5/8 in color and is neutral to moderately alkaline.

Colo series

The Colo series consists of deep, poorly drained soils with moderately slow permeability. These soils formed in silty sediment on drainageways, low benches, and alluvial fans. Slopes range from 0 to 2 percent.

Colo soils are similar to Zook soils and are commonly adjacent to them on bottom lands; they are also adjacent to Adair, Gara, Lamoni, and Shelby soils on the uplands. Zook soils have finer textured sola and are less sloping. Adair, Gara, Lamoni, and Shelby soils formed in glacial material and are on steeper side slopes above the Colo soils.

Typical pedon in an area of Colo silty clay loam, 390 feet south and 130 feet east of the NW corner of sec. 12, T. 63 N., R. 26 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam; weak very fine granular structure; friable; few fine roots; mildly alkaline; abrupt smooth boundary.

A12—8 to 24 inches; black (10YR 2/1) silty clay loam; weak very fine blocky structure; friable; few very fine roots; slightly acid; diffuse smooth boundary.

A13—24 to 35 inches; black (10YR 2/1) silty clay loam; weak fine prismatic structure; firm; slightly acid; diffuse smooth boundary.

AC—35 to 48 inches; very dark gray (10YR 3/1) silty clay loam; weak fine prismatic structure; firm; neutral; diffuse smooth boundary.

C—48 to 62 inches; very dark gray (10YR 3/1) silty clay loam; common fine and medium distinct dark yellowish brown (10YR 4/4) mottles; massive; firm; neutral.

The solum is 36 to 54 inches thick. Reaction ranges from slightly acid to neutral. Color ranges from N 2/0 to 10YR 3/1. The Ap horizon is silt loam, loam, or silty clay loam.

Gara series

The Gara series consists of deep, moderately well drained soils that have moderately slow permeability. These soils formed in clay loam glacial till on uplands. Slopes range from 5 to 20 percent.

Gara soils are similar to Shelby soils. They are commonly adjacent to Adair, Armstrong, Zook, and Colo soils. Adair and Shelby soils have a mollic epipedon that is thicker than 10 inches. Adair and Armstrong soils have

red and gray mottles in the upper part of the B horizon, a fine textured B2 horizon, and are on more gentle side slopes above Gara soils. Zook and Colo soils are poorly drained. They are on bottom lands.

Typical pedon in an area of Gara loam, 14 to 20 percent slopes, in a meadow 1,980 feet west and 820 feet south of the NE corner of sec. 20, T. 64 N., R. 28 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam; moderate fine granular structure; friable; common very fine roots; few fine glacial pebbles; slightly acid; clear smooth boundary.

B1—7 to 10 inches; brown (10YR 4/3) light clay loam; weak very fine subangular blocky structure; firm; common very fine roots; few fine glacial pebbles; strongly acid; clear smooth boundary.

B21t—10 to 15 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; few fine roots; few thin clay films on faces of peds; few fine glacial pebbles; strongly acid; gradual smooth boundary.

B22t—15 to 22 inches; yellowish brown (10YR 5/4) heavy clay loam; common fine faint strong brown (7.5YR 5/8) mottles; moderate fine subangular blocky structure; firm; few very fine roots; common thin clay films on faces of peds; few fine glacial pebbles; strongly acid; gradual smooth boundary.

B23t—22 to 30 inches; yellowish brown (10YR 5/6) heavy clay loam; few fine distinct grayish brown (10YR 5/2) mottles and common fine faint strong brown (7.5YR 5/8) mottles; moderate fine prismatic structure; firm; few thin clay films on faces of peds; few fine glacial pebbles; medium acid; gradual smooth boundary.

B3—30 to 41 inches; yellowish brown (10YR 5/6) clay loam; weak fine prismatic structure; firm; wide (10-30 mm) gray (10YR 6/1) streaks; few fine glacial pebbles and calcium masses; neutral; gradual smooth boundary.

C—41 to 68 inches; mottled gray (10YR 6/1) and strong brown (7.5YR 5/6) clay loam; massive; firm; few soft calcium masses; few fine glacial pebbles; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 36 to 50 inches.

The Ap horizon is black or very dark grayish brown loam and is 6 to 9 inches thick. In some places there is an A2 horizon 1 inch to 3 inches thick.

The B horizon has hue of 10YR or 7.5YR but dominantly 10YR. Value is 4 or 5 and chroma 4 to 8.

Gara clay loam, 9 to 14 percent slopes, severely eroded, has an A horizon that is more clayey and thinner than is defined as the range for the series, but this difference does not significantly affect the use or behavior of the soil.

Gasconade series

The Gasconade series consists of shallow, somewhat excessively drained soils that have moderately slow permeability. These soils formed in interbedded limestone and shale on uplands. Slopes range from 14 to 30 percent.

Gasconade soils are commonly adjacent to Gara soils. Gara soils are deep and formed in glacial till upslope from Gasconade soils.

Typical pedon in an area of Gasconade flaggy silty clay loam, 14 to 30 percent slopes, in timber 2,600 feet south of the center of sec. 27, T. 62 N., R. 26 W.

A1—0 to 6 inches; black (10YR 2/1) flaggy silty clay loam; moderate very fine subangular blocky structure; firm; about 15 percent, by volume, of limestone fragments 1/4 to 1 inch in diameter and up to 3 inches wide, and 20 percent 1 to 2 inches in diameter and 3 to 8 inches wide; common fine and medium roots; neutral; clear smooth boundary.

B—6 to 13 inches; very dark grayish brown (10YR 3/2) flaggy heavy silty clay; moderate fine subangular blocky structure; firm; about 25 to 30 percent, by volume, limestone fragments 1 to 2 inches thick and 3 to 8 inches wide, and about 15 to 20 percent limestone fragments more than 8 inches wide; mildly alkaline; abrupt smooth boundary.

R—13 inches; fractured limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 10 to 20 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has hue of 10YR or 7.5YR, value of 2 to 4, and chroma of 1 to 4. Fragments up to 3 inches in diameter make up 15 to 25 percent of the A horizon and 15 to 40 percent of the B horizon. Coarse fragments more than 3 inches in diameter make up 20 to 60 percent of the solum.

Grundy series

The Grundy series consists of deep, somewhat poorly drained, slowly permeable soils on loess covered uplands. These soils formed in silty noncalcareous loess. Slopes range from 2 to 5 percent.

Grundy soils are similar to Lagonda soils. They are commonly adjacent to Adair, Lagonda, and Lamoni soils. Lagonda soils have more than 10 percent sand in the lower part of the B horizon and are downslope from Grundy soils. Adair and Lamoni soils have glacial sand and pebbles throughout the solum and are on steeper side slopes below Grundy soils.

Typical pedon in an area of Grundy silt loam, 2 to 5 percent slopes, in a cultivated field 1,175 feet east and 125 feet south of the center of sec. 19, T. 65 N., R. 27 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam; weak fine granular structure; friable; common fine and medium roots; neutral; clear smooth boundary.

A12—9 to 11 inches; black (10YR 2/1) light silty clay loam; weak very fine subangular blocky structure; friable; common fine and medium roots; slightly acid; clear smooth boundary.

B1—11 to 14 inches; very dark gray (10YR 3/1) silty clay loam; moderate very fine subangular blocky structure; firm; common fine roots; slightly acid; clear smooth boundary.

B21t—14 to 18 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct yellowish brown (10YR 5/4) mottles in lower part; moderate very fine and fine subangular blocky structure; firm; common fine roots; common moderately thick clay films on faces of peds; medium acid; clear smooth boundary.

B22t—18 to 24 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; many moderately thick clay films on faces of peds; slightly acid; gradual smooth boundary.

B23t—24 to 38 inches; grayish brown (2.5Y 5/2) silty clay; common fine distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; few fine black concretions; few fine black streaks in cracks; common moderately thick clay films on faces of peds; neutral; gradual smooth boundary.

B3t—38 to 53 inches; grayish brown (2.5Y 5.2) silty clay loam; few medium prominent strong brown (7.5YR 5/8) mottles; weak fine prismatic structure parting to weak medium subangular blocky; firm; few fine black streaks in cracks; few thin clay films on faces of peds; neutral; gradual smooth boundary.

C—53 to 72 inches; olive gray (5Y 5/2) light silty clay loam; common fine distinct yellowish brown (10YR 5/4) mottles; massive; firm; neutral.

The solum is 33 to 74 inches thick. The mollic epipedon is 10 to 16 inches thick.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam or light silty clay loam. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2. The average clay content in the upper 20 inches of the argillic horizon ranges from 42 to 45 percent. The B horizon ranges from medium acid to neutral.

The C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It is light silty clay loam or silt loam.

Grundy silty clay loam, 2 to 5 percent slopes, eroded, has a more clayey and a thinner surface layer than is defined as the range for the series, but this difference does not significantly affect the use or behavior of the soil.

Haig series

The Haig series consists of deep, poorly drained, very slowly permeable soils on loess covered uplands. These soils formed in silty noncalcareous loess. Slopes range from 0 to 2 percent.

Haig soils are similar to Grundy soils and are commonly adjacent to them on the landscape. Grundy soils commonly have a mollic epipedon less than 16 inches thick and have colors of higher chroma or fewer mottles directly below the mollic epipedon.

Typical pedon in an area of Haig silt loam, 0 to 2 percent slopes, in a cultivated field 2,100 feet east and 120 feet south of the NW corner of sec. 2, T. 63 N., R. 27 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam; weak fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

A12—10 to 13 inches; very dark gray (10YR 3/1) light silty clay loam; moderate fine subangular blocky structure; friable; common fine roots; slightly acid; clear smooth boundary.

B1t—13 to 16 inches; very dark gray (10YR 3/1) heavy silty clay loam; few fine faint dark brown and common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; common fine roots; common thin clay films on faces of peds; medium acid; clear smooth boundary.

B21t—16 to 23 inches; very dark gray (10YR 3/1) silty clay; common fine faint dark grayish brown (10YR 4/2) mottles and common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; many thick clay films on faces of peds; few black concretions; slightly acid; gradual smooth boundary.

B22gt—23 to 31 inches; dark gray (10YR 4/1) silty clay; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; many thick clay films on faces of peds; few black concretions; slightly acid; gradual smooth boundary.

B23t—31 to 51 inches; grayish brown (2.5Y 5/2) heavy silty clay loam; common fine and medium distinct yellowish brown (10YR 5/6) mottles; weak very fine prismatic structure parting to weak medium subangular blocky; firm; common thin clay film on faces of peds; few black concretions; slightly acid; gradual smooth boundary.

B3—51 to 72 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/8) mottles and stains; weak medium prismatic structure; firm; few fine black concretions; slightly acid; gradual smooth boundary.

C—72 to 84 inches; gray (10YR 5/1) light silty clay loam; few medium distinct yellowish brown (10YR 5/4) mottles; massive; firm; few fine brown concretions and streaks; neutral.

The solum is 50 to 84 inches thick. The mollic epipedon is 14 to 26 inches thick.

The A horizon is black or very dark gray silt loam or light silty clay loam. Mollic color extends into the B1 or B21 horizon and is dominantly very dark gray. The lower part of the B horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 or 5; and chroma of 1 or 2.

Humeston series

The Humeston series consists of deep, poorly drained soils that have very slow permeability. These soils formed in silty alluvium on bottom lands. Slopes range from 0 to 2 percent.

Humeston soils are commonly adjacent to Nodaway and Zook soils. Nodaway soils do not have albic or argillic horizons and are adjacent to stream channels. Zook soils have a black silty clay loam mollic epipedon that is thicker than 36 inches, and they are in nearly level areas and depressions.

Typical pedon in an area of Humeston silt loam, in a pasture 1,200 feet north and 600 feet east of the SW corner of sec. 36, T. 63 N., R. 26 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam; weak very fine granular structure; friable; common very fine roots; medium acid; clear smooth boundary.

A12—7 to 17 inches; black (10YR 2/1) silt loam; moderate very fine granular structure; friable; few very fine roots; strongly acid; clear smooth boundary.

A2—17 to 23 inches; gray (10YR 5/1) silt loam; weak thin platy structure; very friable; few very fine roots; strongly acid; abrupt smooth boundary.

B1—23 to 34 inches; dark gray (10YR 4/1) silty clay loam; weak very fine subangular blocky structure; firm; strongly acid; gradual smooth boundary.

B2—34 to 50 inches; very dark gray (10YR 3/1) silty clay loam; weak fine prismatic structure parting to weak medium subangular blocky; firm; medium acid; gradual smooth boundary.

B3—50 to 67 inches; very dark gray (10YR 3/1) silty clay loam; weak coarse subangular blocky structure; massive; firm; neutral.

The solum is 48 to 72 inches thick. The mollic epipedon is 10 to 20 inches thick.

The A1 horizon is black or very dark gray silt loam or light silty clay loam. The B2 horizon is black or very dark gray silty clay loam or silty clay.

Ladoga series

The Ladoga series consists of deep, moderately well drained soils that have moderately slow permeability. These soils formed in silty noncalcareous loess on uplands. Slopes range from 5 to 9 percent.

Ladoga soils have a slightly higher clay content in the B horizon and a redder color in the lower part of the B3 and C horizons than is defined as the range for the series, but these differences do not significantly affect the use or behavior of the soils.

Ladoga soils are similar to Gara and Weller soils and are commonly adjacent to Gara soils. Gara soils have glacial sand and pebbles throughout the solum and are on steeper side slopes below the Ladoga soils. Weller soils have gray mottles in the upper part of the B horizon and are on low ridges and benches.

Typical pedon in an area of Ladoga silt loam, 5 to 9 percent slopes, in a meadow 42 feet west and 2,525 feet south of the NE corner of sec. 9, T. 62 N., R. 26 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam; weak fine granular structure; friable; many very fine roots; slightly acid; abrupt smooth boundary.

B1—7 to 10 inches; dark yellowish brown (10YR 4/4) light silty clay loam; weak fine subangular blocky structure; firm; many very fine roots; strongly acid; clear smooth boundary.

B21t—10 to 19 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; common very fine roots; few thin clay films on faces of peds; strongly acid; gradual smooth boundary.

B22t—19 to 29 inches; dark yellowish brown (10YR 4/4) light silty clay; common medium distinct brown (10YR 5/3) and few fine distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/8) mottles below 24 inches; moderate fine subangular structure; firm; few very fine roots; common thin clay films on faces of peds; strongly acid; gradual smooth boundary.

B23t—29 to 40 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct brown (10YR 5/3) and few fine distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few thin clay films on faces of peds; strongly acid; gradual smooth boundary.

B31—40 to 51 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine faint dark grayish brown mottles; weak fine and medium prismatic structure; firm; few small black stains; strongly acid; gradual smooth boundary.

B32—51 to 62 inches; dark brown (7.5YR 4/4) silty clay loam; few medium distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure; firm; few small black stains; strongly acid; gradual smooth boundary.

C1—62 to 72 inches; yellowish red (5YR 5/6) light silty clay loam; few fine distinct light brownish gray (10YR 6/2) mottles; massive; firm; few small black stains; medium acid; gradual smooth boundary.

C2—72 to 84 inches; yellowish red (5YR 4/6) silty clay loam; massive; firm; few small black stains; slightly acid.

The solum is 38 to 70 inches thick. The dark surface layer is 6 to 9 inches thick.

The A horizon, if moist, has value of 2 or 3 and chroma of 1 or 2. Most pedons do not have an A2 horizon. The B2 horizon ranges in color from 10YR 4/3 to 10YR 4/4. The clay maximum ranges from heavy silty clay loam to light silty clay. The C horizon has hue of 5YR to 10YR, value of 5, and chroma of 4 to 6. Many areas are underlain by limestone bedrock at 5 to 9 feet.

Lagonda series

The Lagonda series consists of deep, somewhat poorly drained, slowly permeable soils on loess covered uplands. These soils formed in 20 to 36 inches of loess or silty sediment underlain by highly weathered material that washed from glacial till. Slopes range from 2 to 9 percent.

Lagonda soils in Harrison County typically have an A horizon that is thinner than is defined as the range for the series, but this difference does not significantly affect the use or management of the soils. Lagonda silt loam, 2 to 5 percent slopes, has a black surface layer more than 10 inches thick and is in the normal range of the series.

Lagonda soils are similar to Grundy soils and are commonly adjacent to the Adair, Grundy, and Lamoni soils on the landscape. Grundy soils formed entirely in loess more than 6 feet thick and typically are on gentler side slopes above Lagonda soils. Adair and Lamoni soils have glacial sand and pebbles throughout their sola and are downslope from Lagonda soils.

Typical pedon in an area of Lagonda silt loam, 5 to 9 percent slopes, eroded, in a meadow 2,240 feet north and 1,000 feet west of the center of sec. 12, T. 64 N., R. 28 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam; weak very fine granular structure; friable; common fine and very fine roots; neutral; abrupt smooth boundary.

B1—7 to 11 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark gray (10YR 3/1) coating on some peds; common fine distinct yellowish brown (10YR 5/8) mottles; moderate very fine subangular blocky structure; firm; common very fine roots; medium acid; clear smooth boundary.

B21t—11 to 16 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; firm; few very fine roots; many moderately thick very dark gray (10YR 3/1) clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—16 to 25 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine distinct yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure; firm; few very fine roots; common moderately thick clay films on faces of peds; few thick very dark gray (10YR 3/1) clay films in vertical cracks; neutral; gradual smooth boundary.

IIB23t—25 to 40 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) silty clay; weak medium prismatic structure; firm; few very fine roots; few thin clay films on faces of peds; few black stains in small root channels; common very fine sand grains; neutral; gradual smooth boundary.

IIB3—40 to 61 inches; yellowish brown (10YR 5/8) silty clay; common medium distinct gray (10YR 5/1) mottles; massive; firm; many fine sand grains and few fine white grit; few black stains; neutral; gradual smooth boundary.

IIC—61 to 72 inches; strong brown (7.5YR 5/8) and gray (10YR 5/1) heavy clay loam; massive; firm; many sand grains and white grit; few soft calcium masses; neutral.

The solum is 40 to 70 inches thick. The dark surface layer is 6 to 9 inches thick.

The A horizon has value of 2 or 3 and chroma of 1. It is silt loam or light silty clay loam. Depth to a marked sand increase in the lower part of the B horizon ranges from 24 to 32 inches. The C horizon has hue of 5Y to 7.5YR, value of 5, and chroma of 1 to 8.

Lamoni series

The Lamoni series consists of deep, somewhat poorly drained, very slowly permeable soils on the uplands. These soils formed in weathered glacial till. Slopes range from 5 to 9 percent.

Lamoni soils in Harrison County have a dark surface layer that is thinner than is defined as the range for the series but this difference does not significantly affect the use or behavior of the soils.

Lamoni soils are similar to Adair soils and are commonly adjacent to Shelby, Zook, and Colo soils. Adair soils have redder colors in the upper part of the B horizon. Shelby soils have less clay and do not have gray mottles in the upper part of the B horizon. They are on steeper side slopes below Lamoni soils. Zook and Colo soils have a black mollic epipedon that is more than 36 inches thick, and they are on the bottom lands.

Typical pedon in an area of Lamoni clay loam, 5 to 9 percent slopes, eroded, in a meadow 400 feet west and 595 feet south of the NE corner of sec. 14, T. 63 N., R 28 W.

Ap—0 to 9 inches; black (10YR 2/1) light clay loam; weak fine granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

B1—9 to 12 inches; brown (10YR 4/3) light clay loam; small black (10YR 2/1) streaks in cracks; weak very fine subangular blocky structure; firm; common fine roots; slightly acid; clear smooth boundary.

IIB21t—12 to 16 inches; dark yellowish brown (10YR 4/4) light clay; few fine distinct yellowish red (5YR 4/6) mottles, common fine faint yellowish brown (10YR 5/8) mottles, and few fine faint dark grayish

brown mottles; moderate fine subangular blocky structure; firm; few very fine roots; common thin clay films on faces of peds; medium acid; gradual smooth boundary.

IIB22t—16 to 23 inches; dark grayish brown (10YR 4/2) clay; common fine distinct yellowish red (5YR 4/6) mottles and common fine faint yellowish brown (10YR 5/8) mottles; moderate medium prismatic structure; firm; few very fine roots; common thin clay films on faces of peds; medium acid; gradual smooth boundary.

IIB23t—23 to 31 inches; grayish brown (10YR 5/2) light clay; medium fine distinct yellowish brown (10YR 5/8) mottles; weak fine prismatic structure; firm; few very fine roots; few thin clay films on faces of peds; strongly acid; gradual smooth boundary.

IIB3—31 to 44 inches; strong brown (7.5YR 5/6) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; common black stains; weak fine prismatic structure; firm; slightly acid; gradual smooth boundary.

IIC—44 to 66 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) clay loam; massive; firm; neutral.

The solum is 38 to 50 inches thick. The dark surface layer is 4 to 10 inches thick.

The A horizon is black or very dark gray. It is dominantly clay loam but the range includes loam and silty clay loam. The upper part of the B horizon ranges in color from 10YR 4/4 to 10YR 4/2. Many pedons do not have red mottles in the upper part of the B horizon. In some pedons the C horizon has mottles of 1 chroma. The C horizon ranges from neutral to mildly alkaline and has soft calcium deposits.

Nodaway series

The Nodaway series consists of deep, moderately well drained, moderately permeable soils on bottom lands. These soils formed in silty alluvial sediment. Slopes range from 0 to 2 percent.

Nodaway soils are commonly adjacent to Humeston and Zook soils. Humeston soils have a fine textured B2 horizon and commonly form a belt between Zook and Nodaway soils. Zook soils have a thick, black, fine textured A horizon and are in nearly level areas or in depressions.

Typical pedon in an area of Nodaway silt loam in a cultivated field 670 feet west and 850 feet south of the NE corner of sec. 20, T. 63 N., R. 28 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; few fine dark grayish brown (10YR 4/2) silt coatings on faces of some peds; small broken pieces of recent strata; weak very fine granular structure; friable; common very fine roots; neutral; abrupt smooth boundary.

A12—8 to 15 inches; very dark grayish brown (10YR 3/2) silt loam; few thin platelike strata; weak very fine granular structure; friable; few very fine roots; neutral; gradual smooth boundary.

C1—15 to 32 inches; very dark grayish brown (10YR 3/2) silt loam; few thin strata of dark grayish brown (10YR 4/2); massive; friable; few very fine roots; neutral; gradual smooth boundary.

C2—32 to 67 inches; very dark grayish brown (10YR 3/2) silt loam; some dark grayish brown (10YR 4/2) strata 2 to 5 millimeters thick; massive; friable; neutral; gradual smooth boundary.

C3—67 to 75 inches; stratified very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silt loam; some layers of very fine sandy loam up to 1 inch thick; platelike structure; mildly alkaline.

The A horizon is as dark as 10YR 3/2 and is 10 to 20 inches thick. The A horizon has few to many thin silt loam strata of 10YR 4/2. The Ap horizon in some places may show no evidence of recent strata.

The C horizon has varied sequence and thickness of strata. It has value of 3 or 4 and chroma of 2. The C horizon has some very thin strata of sand at a depth of less than 40 inches; and in some pedons there are sandy layers 1 inch to 10 inches thick below a depth of 40 inches.

Pershing series

The Pershing series consists of deep, somewhat poorly drained, slowly permeable soils on loess covered uplands. These soils formed in silty noncalcareous loess. Slopes range from 2 to 9 percent.

Pershing soils in Harrison County are browner in the upper part of the B horizon and have a thinner solum than is defined as the range for the series, but these differences do not significantly affect the use or behavior of the soils. Also, the severely eroded phase has a thinner surface layer.

Pershing soils are similar to Grundy soils and are commonly adjacent to Armstrong and Gara soils on the landscape. Grundy soils have a mollic epipedon. Armstrong and Gara soils have glacial sand and pebbles throughout their sola and are downslope from Pershing soils.

Typical pedon in an area of Pershing silt loam, 2 to 5 percent slopes, in a meadow 1,420 feet east and 1,200 feet north of the SW corner of sec. 6, T. 64 N., R. 27 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam; weak very fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

B1—6 to 9 inches; brown (10YR 4/3) light silty clay loam; streaks of very dark grayish brown (10YR 3/2) in cracks; moderate fine granular and weak very fine subangular blocky structure; firm; few very fine roots; slightly acid; abrupt smooth boundary.

B21t—9 to 14 inches; dark yellowish brown (10YR 4/4) heavy silty clay loam; few fine distinct dark grayish brown (10YR 4/2) mottles; moderate very fine subangular blocky structure; firm; few very fine roots; few moderately thick clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—14 to 22 inches; dark grayish brown (10YR 4/2) silty clay; many fine distinct dark yellowish brown (10YR 4/4) mottles and few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure; firm; few very fine roots; common moderately thick clay films on faces of peds; medium acid; gradual smooth boundary.

B23t—22 to 29 inches; grayish brown (10YR 5/2) heavy silty clay loam; many fine and medium distinct dark brown (7.5YR 4/4) mottles; moderate medium prismatic structure; firm; few very fine roots; common thin clay films on faces of peds; slightly acid; gradual smooth boundary.

B3—29 to 37 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct dark brown (7.5YR 4/4) mottles; weak medium prismatic structure; firm; neutral; gradual smooth boundary.

C1—37 to 59 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct dark brown (7.5YR 4/4) mottles; massive; firm; common very dark brown stains; neutral; gradual smooth boundary.

C2—59 to 70 inches; dark yellowish brown (10YR 4/4) light silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; massive; firm; mildly alkaline.

The solum is 36 to 60 inches thick. The dark surface layer is 6 to 9 inches thick.

Some pedons have an A2 horizon 1 inch to 3 inches thick. The B horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 4. Some pedons have some sand and grit in the lower sola that formed in paleosols. The C horizon is silt loam, silty clay loam, or light clay loam.

Shelby series

The Shelby series consists of deep, moderately well drained soils that have moderately slow permeability. These soils formed in clay loam glacial till on uplands. Slopes range from 9 to 20 percent.

Shelby soils are similar to Gara soils. They are commonly adjacent to Adair, Lamoni, Zook, and Colo soils. Gara soils do not have a mollic epipedon. Adair and Lamoni soils have a fine textured B horizon that has gray mottles in the upper part. These soils are on gentler slopes above Shelby soils. Zook and Colo soils formed in alluvium and are on narrow bottom lands.

Typical pedon in an area of Shelby loam, 14 to 20 percent slopes, in a pasture 2,140 feet east and 50 feet north of the SW corner of sec. 31, T. 66 N., R. 28 W.

A1—0 to 8 inches; black (10YR 2/1) loam; weak fine granular structure; friable; common fine roots; very slightly acid; clear smooth boundary.

A12—8 to 12 inches; very dark brown (10YR 2/2) loam; weak fine granular structure; friable; common fine roots; neutral; clear smooth boundary.

B1—12 to 16 inches; dark brown (10YR 4/3-3/3) light clay loam; few black (10YR 2/1) streaks; weak very fine subangular blocky structure; friable; few fine roots; slightly acid; gradual smooth boundary.

B21t—16 to 21 inches; dark yellowish brown (10YR 4/4) clay loam; few very dark grayish brown (10YR 3/2) stains; weak fine subangular blocky structure; firm; few glacial pebbles; few fine roots; slightly acid; gradual smooth boundary.

B22t—21 to 30 inches; yellowish brown (10YR 5/4) clay loam; moderate fine subangular blocky structure; firm; few glacial pebbles; few thin clay films on faces of peds; neutral; gradual smooth boundary.

C1—30 to 41 inches; yellowish brown (10YR 5/4) clay loam; few medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few glacial pebbles; soft calcium masses; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—41 to 66 inches; yellowish brown (10YR 5/6) clay loam; few fine distinct light brownish gray (10YR 6/2) streaks; massive; firm; few glacial pebbles; common small calcium masses; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 28 to 48 inches. The mollic epipedon is 10 to 16 inches thick.

The A horizon is dominantly black loam but the range includes light clay loam. The A horizon has value of 2 or 3 and chroma of 1 or 2. The lower part of the B horizon is slightly acid or medium acid. The C horizon is dominantly 10YR 5/4 to 5/6 in color and has few to common gray mottles that have chroma of 2. Some pedons have a dominantly gray C horizon.

Shelby clay loam, 9 to 14 percent slopes, severely eroded, and Shelby clay loam, 14 to 20 percent slopes, severely eroded, have a thinner dark surface layer than is defined as the range for the series, but this difference does not significantly affect the use or behavior of these soils.

Wabash series

The Wabash series consists of deep, very poorly drained, very slowly permeable soils on large flood plains. These soils formed in fine textured alluvial sediment. Slopes range from 0 to 1 percent.

Wabash soils are similar to Zook soils and are commonly surrounded on the landscape by Zook soils. Zook soils have less clay in their sola and are in areas slightly higher than Wabash soils.

Typical pedon in an area of Wabash silty clay, in a meadow 1,520 feet east and 1,020 feet south of the NW corner of sec. 9, T. 62 N., R. 28 W.

Ap—0 to 8 inches; black (10YR 2/1) light silty clay; moderate fine subangular blocky structure; firm; common very fine roots; slightly acid; clear smooth boundary.

A12—8 to 18 inches; black (10YR 2/1) silty clay; moderate fine subangular blocky structure; firm; common very fine roots; medium acid; gradual smooth boundary.

B1g—18 to 37 inches; very dark gray (10YR 3/1) silty clay; common fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; very firm; few very fine roots; medium acid; gradual smooth boundary.

B2g—37 to 53 inches; dark gray (10YR 4/1) silty clay; few fine faint dark brown mottles; weak fine subangular blocky structure; firm; slightly acid; gradual smooth boundary.

B3g—53 to 68 inches; dark gray (10YR 4/1) light silty clay; moderate fine subangular blocky and weak fine prismatic structure; firm; slightly acid; gradual smooth boundary.

Cg—68 to 83 inches; dark gray (10YR 4/1) light silty clay; massive; firm; slightly acid.

The solum is 36 to 60 inches thick. It has value of 3 or lower to a depth of 36 to 48 inches.

The upper part of the A horizon is silty clay loam or silty clay. The C horizon has value of 4 or 5 and chroma of 1.

Weller series

The Weller series consists of deep, moderately well drained, slowly permeable soils on low loess-covered ridges and benches. These soils formed in thin noncalcareous loess. Slopes range from 2 to 9 percent.

Weller soils are similar to Ladoga and Pershing soils. They are commonly adjacent to Armstrong, Gara, and Pershing soils. Pershing soils have a thicker or darker colored A1 horizon, a grayer B horizon, and are upslope from Weller soils. Armstrong and Gara soils have glacial sand and gravel throughout their sola and are downslope from Weller soils. Ladoga soils have a darker A1 horizon and a browner B horizon.

Typical pedon in an area of Weller silt loam, 2 to 5 percent slopes, in a cultivated field 1,450 feet south and 99 feet west of the center of sec. 32, T. 63 N., R. 28 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak very fine granular structure; friable; few fine roots; neutral; abrupt smooth boundary.

B1—8 to 12 inches; brown (10YR 5/3) light silty clay loam; few thin grayish brown silt coatings on vertical surface of peds and in cracks; weak very fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

B21t—12 to 19 inches; yellowish brown (10YR 5/4) light silty clay; few fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate very fine subangular blocky; firm; few very fine roots; few thin clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—19 to 24 inches; yellowish brown (10YR 5/4) light silty clay; few fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate very fine and fine subangular blocky; firm; common fine black concretions; few thin clay films on faces of peds; very strongly acid; gradual smooth boundary.

B23t—24 to 34 inches; brown (10YR 5/3) silty clay loam; few medium distinct grayish brown (10YR 5/2) mottles and few fine distinct yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; firm; common fine black concretions; few thin clay films on faces of peds; strongly acid; gradual smooth boundary.

B3—34 to 64 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/8) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; common fine black concretions; few black stains; medium acid; gradual smooth boundary.

C—64 to 89 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) light silty clay loam; medium fine distinct dark yellowish brown (10YR 4/4) mottles and common fine distinct yellowish brown (10YR 5/8) mottles; massive; firm; few black stains and concretions; slightly acid.

The solum is 60 to 90 inches thick. The silt loam surface layer is 5 to 8 inches thick.

The A horizon has value of 3 or 4 and chroma of 2. It is silt loam or silty clay loam. Many pedons have a grayish brown or brown A2 horizon. The B horizon has value of 5 and chroma of 2 to 4. Some pedons have more than 10 percent sand in the C horizon.

Zook series

The Zook series consists of deep, poorly drained, slowly permeable soils on bottom lands. These soils formed in alluvial sediment. Slopes range from 0 to 1 percent.

Zook soils are similar to Wabash soils. They are commonly adjacent to Colo, Humeston, and Wabash soils. Colo soils have less clay in their sola and are in slightly higher areas next to the uplands. Humeston soils have a silt loam surface layer and are in slightly higher areas. Wabash soils have more clay in their sola and are in slightly lower areas.

Typical pedon in an area of Zook silty clay loam, in a cultivated field 100 feet east and 1,420 feet south of the NW corner of sec. 9, T. 62 N., R. 28 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam; weak very fine subangular blocky structure; friable; few very fine roots; slightly acid; clear smooth boundary.

A12—9 to 17 inches; very dark gray (10YR 3/1) silty clay loam; gray (10YR 5/1) coatings on faces of peds; few fine faint dark yellowish brown mottles; moderate very fine subangular blocky structure; firm; few very fine roots; slightly acid; gradual smooth boundary.

A13—17 to 29 inches; very dark gray (10YR 3/1) silty clay; moderate fine subangular blocky structure; firm; few very fine roots; slightly acid; gradual smooth boundary.

A14—29 to 37 inches; very dark gray (10YR 3/1) light silty clay; few fine faint dark yellowish brown mottles; moderate fine subangular blocky structure; firm; slightly acid; gradual smooth boundary.

Bg—37 to 66 inches; dark gray (10YR 4/1) light silty clay; common fine distinct yellowish gray (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; slightly acid; gradual smooth boundary.

Cg—66 to 85 inches; dark gray (10YR 4/1) light silty clay; common fine faint dark yellowish brown (10YR 4/4) mottles; massive; firm; neutral.

The solum and mollic epipedon are 36 to 50 inches thick. The A horizon is 20 to 36 inches thick.

The surface layer dominantly is silty clay loam but the range includes silt loam. The B horizon is silty clay loam or light silty clay. The C horizon has value of 4 or 5 and chroma of 1.

Formation of the soils

This section describes the factors of soil formation and how they relate to the formation of soils in the survey area, and it explains the process of soil formation.

Factors of soil formation

Soil is the product of soil-forming processes acting on accumulated or deposited geologic materials. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and in extreme cases determines it almost entirely. Finally, time is needed for changing the parent material into a soil that has distinct horizons. Although it varies, some time is always required for differentiation of soil horizons. Generally, a long time is required for distinct horizons to form.

The factors of soil formation are so closely interrelated in their effect on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified for the other four.

Plants and animals

Plants, burrowing animals, insects, bacteria, and fungi are important in the formation of soils. They affect the organic matter, plant nutrients, structure, and porosity of soils.

Many of the soils in Harrison County formed when the vegetation was mainly tall prairie grasses. These soils, generally known as prairie soils, have a thick dark colored surface layer that has a high content of organic matter because of abundant bacteria and decayed fine grass roots. Soils that formed under this kind of plant cover include the Adair, Grundy, Haig, Lagonda, Lamoni, and Shelby soils.

Soils that formed under forest vegetation have a surface layer that is thin and dark colored, for example, the Weller soils.

Several soils in Harrison County have been influenced by grass and trees. They have properties intermediate between those of soils that formed under grass and those of soils that formed under trees. These soils, generally known as transitional soils, are the Armstrong, Gara, Ladoga, and Pershing soils.

Worms, insects, burrowing animals, large animals, and man affect and disturb the soil. Bacteria and fungi, however, contribute more toward the formation of soils than do animals. Bacteria and fungi cause rotting of organic materials, improve tilth, and fix nitrogen in the soils. The population of soil organisms is directly related to the rate of decomposition of organic material in the soil. The kinds of organisms in a given area and their activity are determined by differences in the vegetation.

Man has had a tremendous effect on the soils of this county. Because of intensive cultivation and overgrazing, erosion has been severe on more than 50,000 acres. As much as 15 inches of topsoil has been lost from these areas. In many areas the soils are still eroding at a rate in excess of that tolerable to sustain production.

Climate

Climate has been an important factor in the formation of the soils in Harrison County. In the past one million years variations in the climate have drastically affected the area.

Harrison County has a subhumid midcontinental climate that has changed little in the past 6,500 years. This period has been drier than previous ones and more favorable for native prairie grasses. Most of the soils have dark colored layers in the upper part of the profile, which indicates that the soils formed under prairie vegetation. Grundy and Shelby soils are examples.

The period between 6,500 years ago and 20,000 years ago was cool and moist. The climate was favorable for the growth of forest vegetation. Since that period, the forest vegetation diminished, except in some areas near streams. Some soils in Harrison County have a moderately thick, dark surface layer, which indicates that the soils formed under transitional prairie-timber vegetation. Armstrong, Gara, and Pershing soils are examples.

Changes in climate caused the glacial periods. Thousands of years of cool temperatures resulted in the massive glaciers of the Nebraska and Kansas ages. Warmer temperatures later resulted in severe geological erosion and the blowing of the loess that covered most of Harrison County at one time. Extreme changes in climate occurred very slowly; therefore there were long intermediate periods when different types of vegetation grew. Soils formed on the surface and were later covered by loess, truncated, and mixed by erosion or completely washed away. Some soils formed mostly in these old truncated or weathered areas, for example, the Adair, Armstrong, and Lamoni soils.

The prevailing winds are from the southwest. Most of the loess, therefore, was blown in a northeasterly direction, probably from the bottom lands of the Missouri River and other large streams. The distance that the loess is carried by the wind depends on the size of the particles. Because most of the loess that covered Harrison County was fine silt and clay, the soils that formed in loess have a clayey subsoil. Grundy, Lagonda, and Pershing soils are examples.

Local conditions can modify the influence of the general climate in a region. For example, south-facing slopes are warmer and drier than north-facing slopes, and low-lying, poorly drained soils on bottom lands stay wetter and cooler longer than the soils around them. These local differences influence the characteristics of the soil and account for some of the local differences among soils.

Parent material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineral composition of the soil. In Harrison County, the soils formed in loess, glacial till, alluvium, or residual material or in a combination of these materials.

Loess is wind-deposited silty material. It probably was blown from the larger flood plains. Loess remains on most of the wider ridges and is 10 feet thick in some areas. In Harrison County, Haig, Grundy, Ladoga, Pershing, and Weller soils formed in loess. Lagonda soils formed in thin loess and the underlying glacial till.

Prior to the deposits of loess, thick layers of glacial till were deposited over the bedrock. This glacial till generally is yellowish brown and is a heterogeneous mass of sand, silt, and clay material ranging in size from small pebbles to boulders. The glacial till ranges in thickness from a few feet to more than 300 feet. In some areas, soil formed in the glacial till before the loess was deposited. In many of these areas the glacial material is now exposed at the surface. The soils are generally in narrow areas, and the surface layer, which formed at a later time, varies in thickness. Adair, Armstrong, and Lamoni are such soils. In steeper areas, the unweathered glacial material was exposed by geologic erosion at a later time. Gara and Shelby soils formed in this material.

Alluvium is soil material that was transported by water and deposited on the nearly level flood plains of streams. Most of this material came from the surrounding uplands. The material ranges from clay and silt to fine sand. Colo, Wabash, and Zook soils formed in the clayey material, and Humeston and Nodaway soils formed in the more silty material.

Residual material in Harrison County consists of material that weathered from shale and limestone beds. The limestone layers generally are thicker than those of shale and are above the shale. Gasconade soils formed in residual material.

Relief

Relief influences soil formation mostly through its effect on drainage, runoff, and erosion.

The amount of water entering and passing through the soil depends on the steepness of the slope, the permeability of the soil material, and the amount and intensity of rainfall. Because runoff is rapid on steep soils, very little water passes through the soil material, resulting in little development of distinct horizons. Runoff is slight on gently sloping or nearly level soils, and most of the water passes through the soil material. Such soils have maximum profile development. On similar slopes, soils that have rapid permeability will form more slowly than soils that have slow permeability.

In general, because they receive more direct sunrays, the soils on steep south-facing slopes are more droughty than those soils that formed in similar material on north-facing slopes. Droughtiness influences soil formation

through its effect on the amount and kind of vegetation, erosion, and freezing and thawing.

Time

The degree of profile development is reflected by the length of time that the parent material has been in place and subject to weathering. Young soils show little profile development or horizon differentiation. Old soils show the effects of clay movement and leaching, and they have clearly distinct horizons.

Alluvial soils are the youngest soils in Harrison County. Nodaway soils have no profile development because alluvial material is added to the surface nearly every year. Humeston soils are the oldest alluvial soils in the survey area. They are on the higher bottom lands and have moderate profile development.

Older than the alluvial soils in the county are the Gara and Shelby soils, which formed on dissected slopes of the Late Wisconsin Recent age, probably 11,000 to 14,000 years ago (*9*). Grundy, Haig, Ladoga, Lagonda, Pershing, and Weller soils formed in loess material of the Early Wisconsin age, probably 14,000 to 16,000 years ago.

The oldest soils are the Adair and Armstrong soils, which formed in weathered material of the Late Sangamon age (*9*), about 38,000 years ago, and Lamoni soils, which formed in material of the Yarmouth interglacial period (*8*), more than 150,000 years ago.

In places in Harrison County, rocky residual material has been exposed by geologic erosion. This material is very old, but the soils show little profile development because of the steep slopes and shallow material. The shallow Gasconade soils are an example.

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Glossary

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Compressible. Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 or 80 inches (1 or 2 meters).

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity*, or *capillary capacity.*

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average

of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the basis of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Polypedon. A volume of soil having properties within the limits of a soil series, the lowest and most homogeneous category of soil taxonomy. A "soil individual."

Poorly graded. Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake. The slow movement of water into the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Illustrations

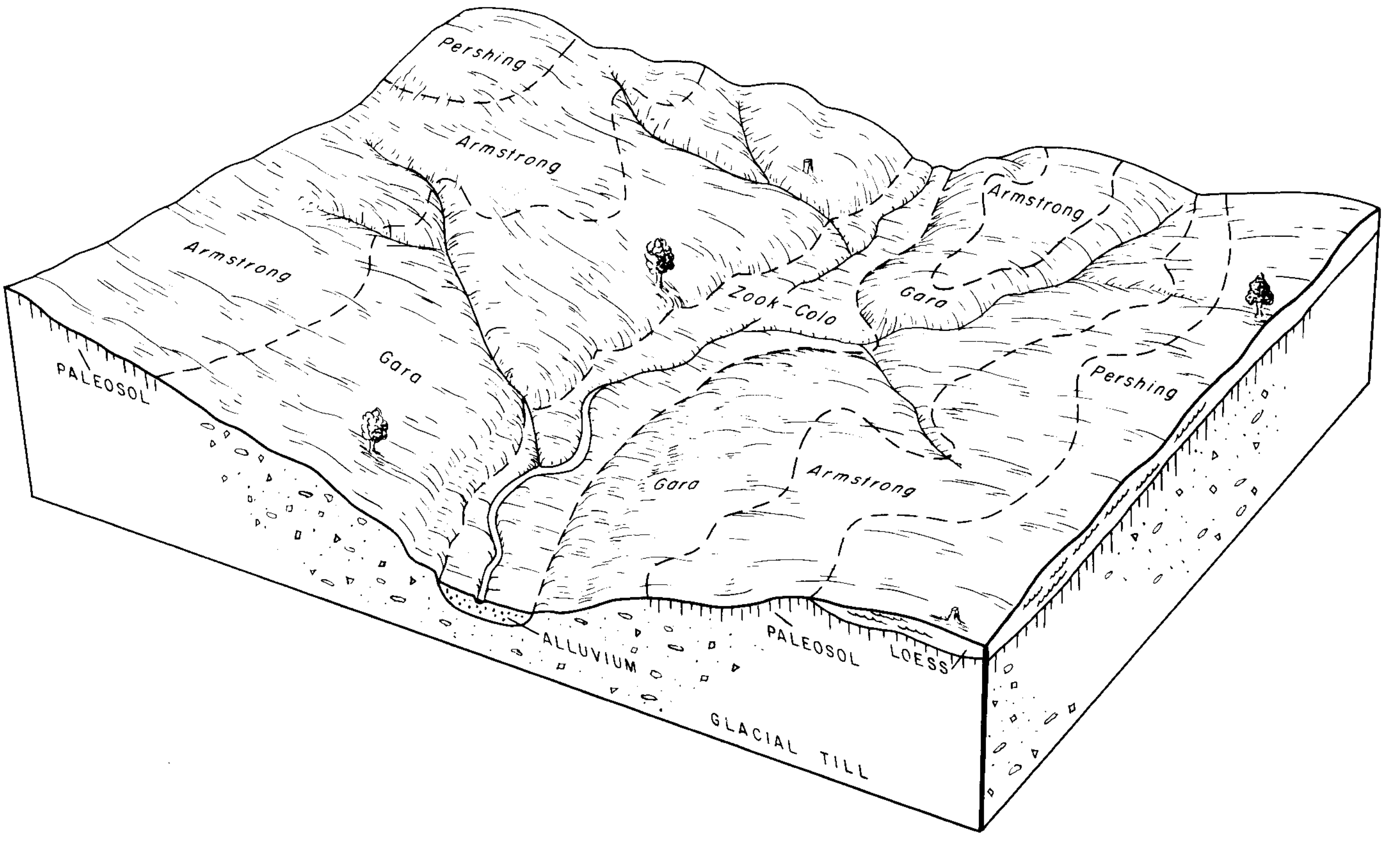

Figure 1.—Typical pattern of soils and parent material in the Gara-Pershing-Armstrong map unit.

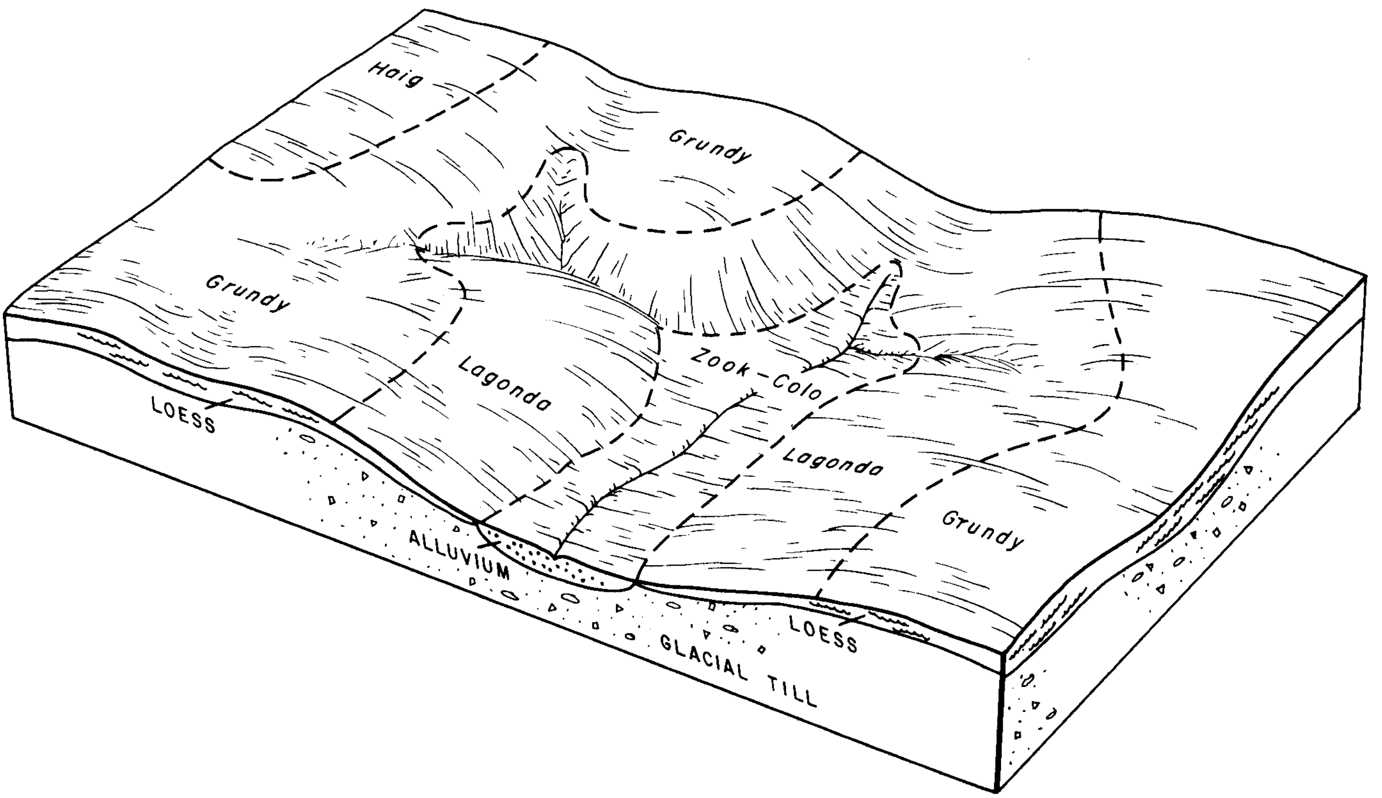

Figure 2.—Typical pattern of soils and parent material in the Grundy-Lagonda map unit.

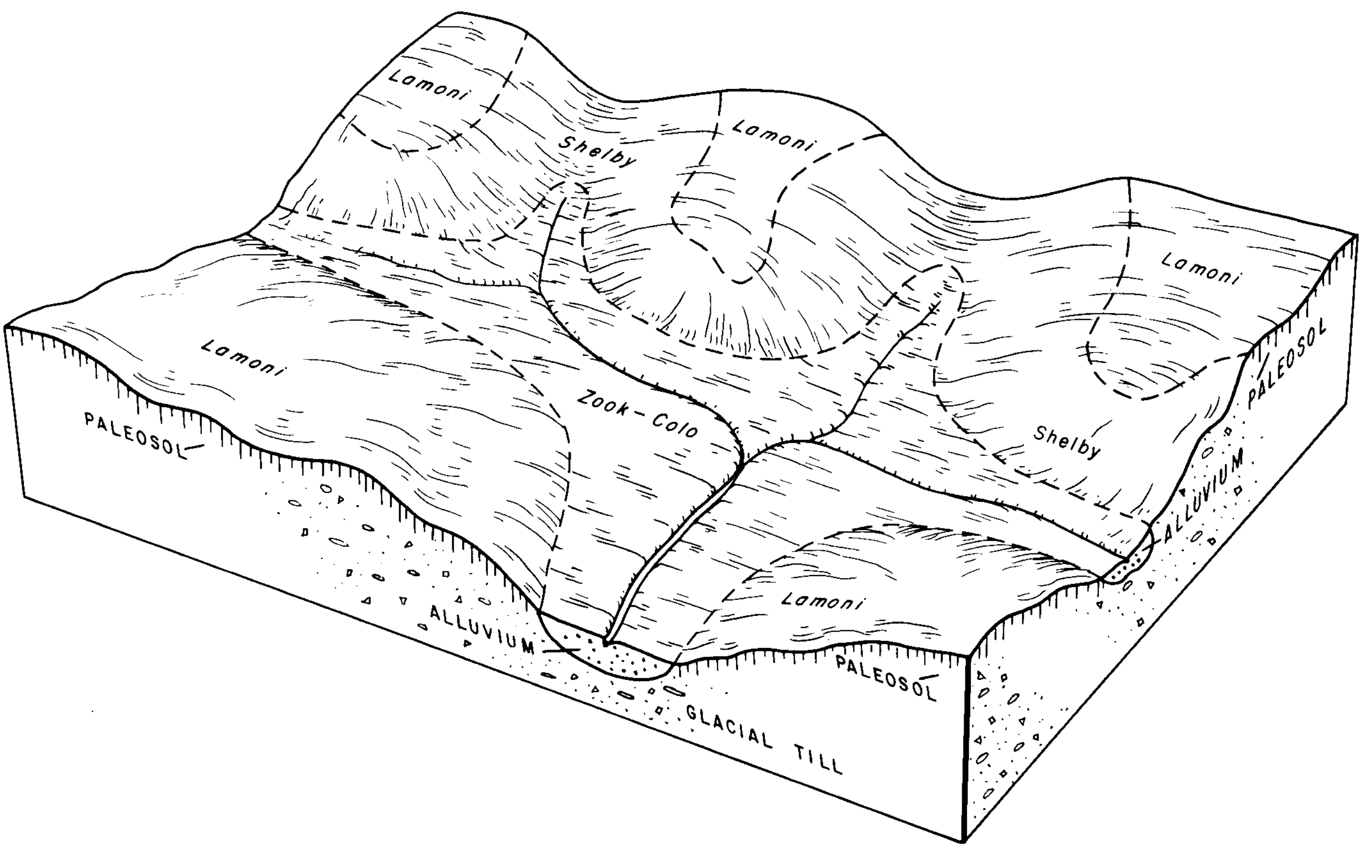

Figure 3.—Typical pattern of soils and parent material in the Lamoni-Shelby-Zook map unit.

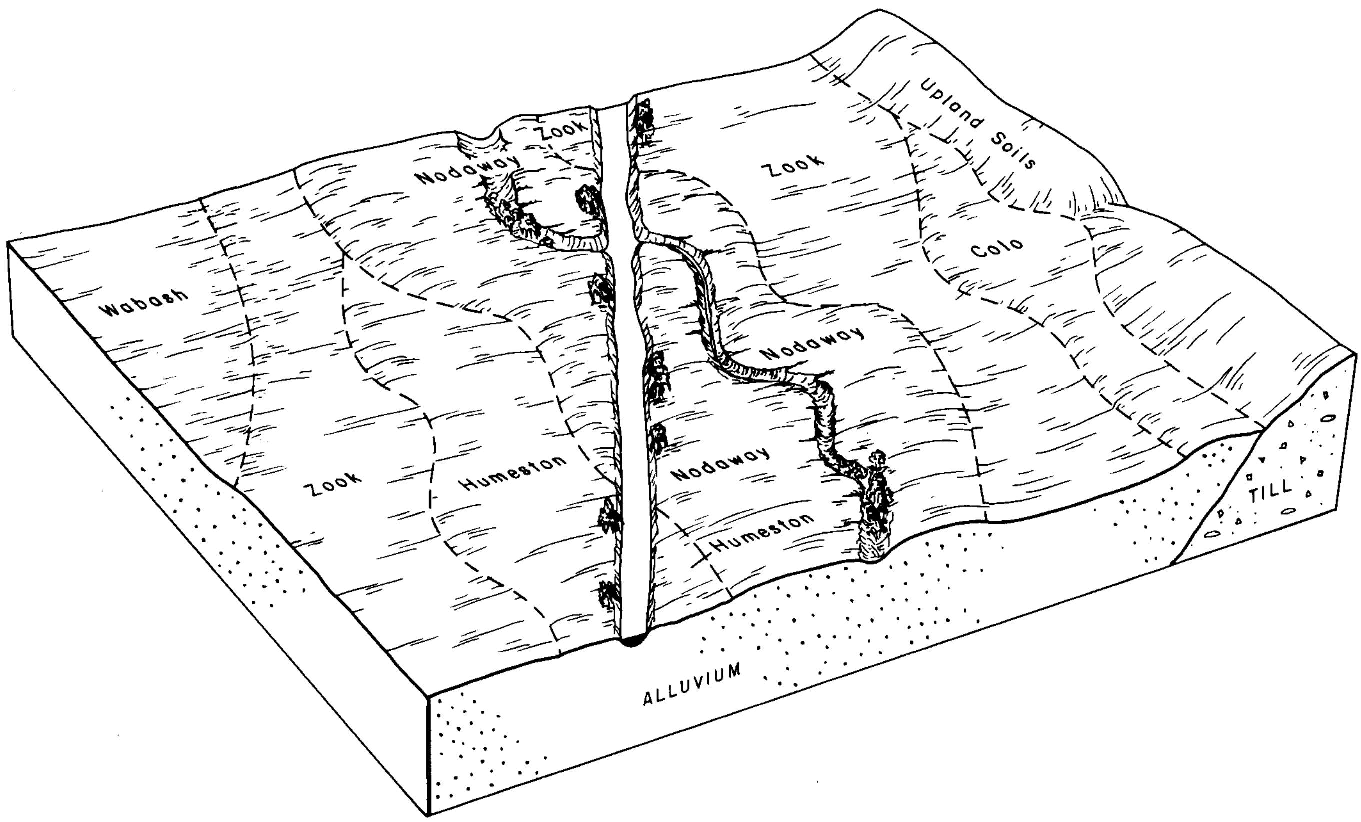

Figure 4.—Typical pattern of soils and parent material in the Nodaway-Zook map unit.

Figure 5.—Grundy silt loam, 2 to 5 percent slopes, has good potential for cultivated crops, hay, and pasture.

Figure 6.—Contour farming and grassed waterways are used on Lamoni clay loam, 5 to 9 percent slopes, eroded to help prevent erosion.

Figure 7.—Nodaway silt loam along meanders of Panther Creek is subject to occasional flooding.

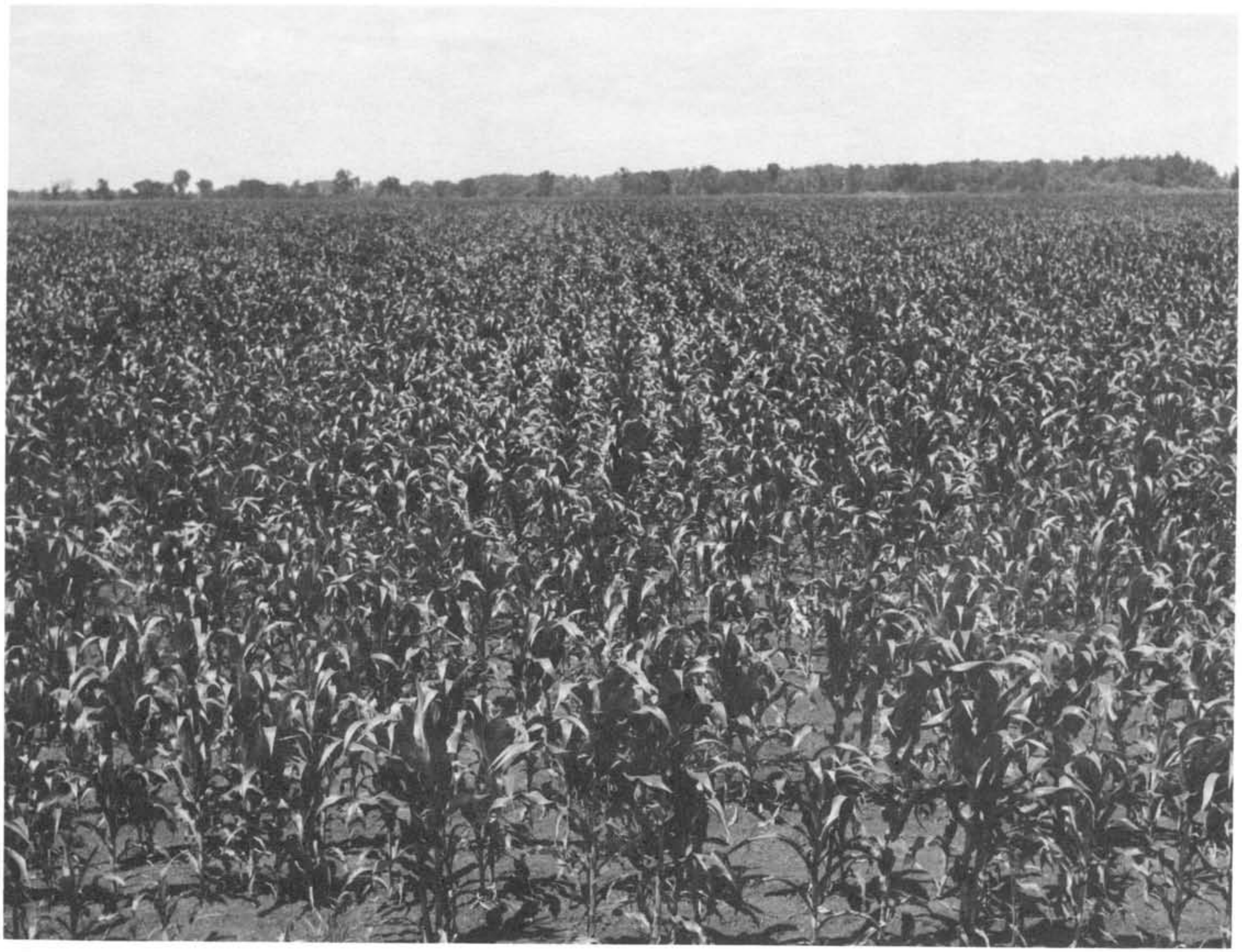

Figure 8.—Wabash silty clay is suited to corn. Because of poor surface drainage this field has been landgraded.

Figure 9.—Lagonda silt loam, 5 to 9 percent slopes, eroded, can be severely damaged by erosion if it is used for cultivated crops.

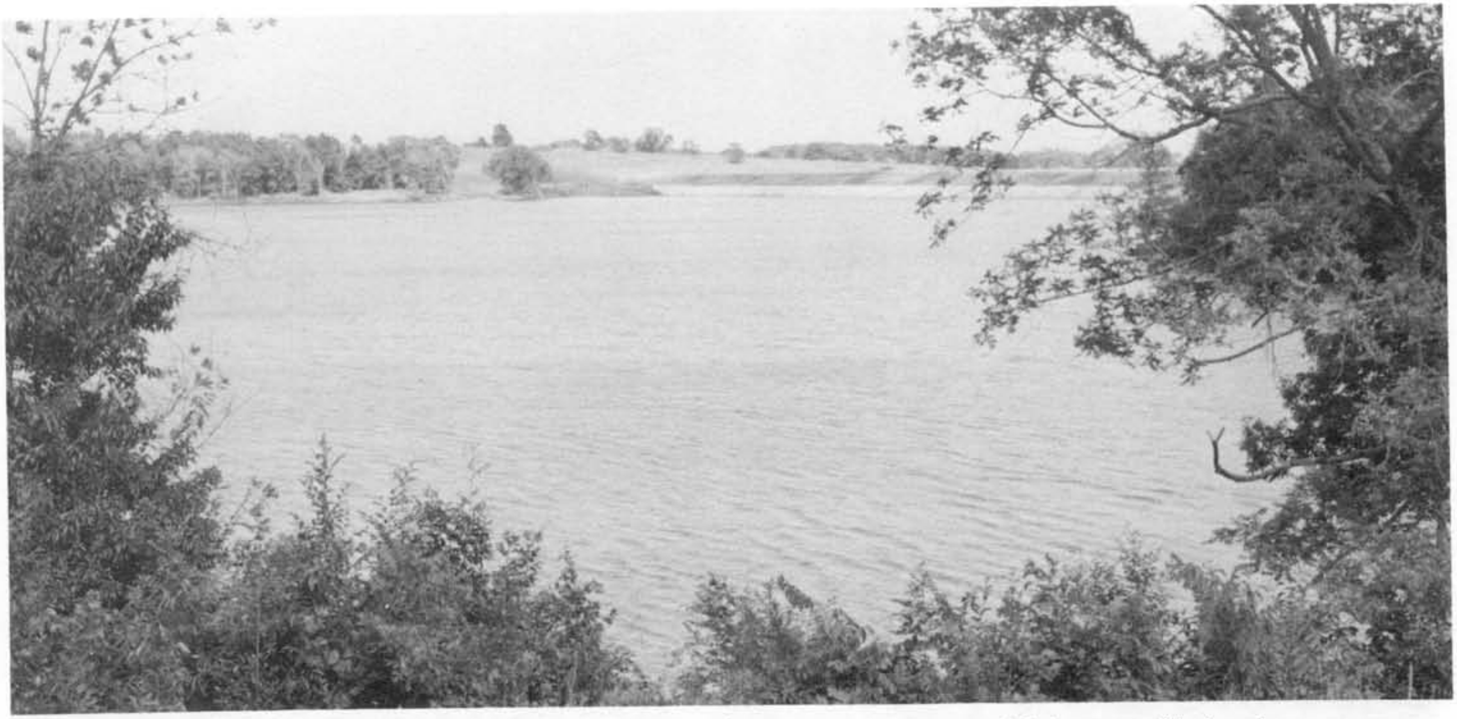

Figure 10.—This watershed lake in an area of the Gara-Pershing-Armstrong map unit helps prevent floods and provides community recreation.

Figure 11.—The meadow and brushy draw on Adair and Shelby soils provide good cover for deer, quail, rabbit, and pheasant.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature[1]						Precipitation[1]				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[2]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	34.6	13.8	24.2	63	-18	0	.99	.26	1.57	3	7.1
February---	41.0	19.6	30.3	68	-12	0	1.06	.41	1.58	3	4.5
March------	51.1	27.9	39.5	80	0	51	2.28	.91	3.38	5	5.6
April------	65.9	40.4	53.2	88	19	144	3.34	1.74	4.64	7	1.0
May--------	76.0	51.1	63.6	91	30	427	4.29	3.05	5.43	8	.0
June-------	84.5	60.5	72.5	97	42	675	4.71	2.93	6.31	8	.0
July-------	89.2	64.5	76.9	103	46	834	3.97	2.02	5.56	6	.0
August-----	87.4	62.1	74.8	100	45	769	4.16	2.18	5.78	6	.0
September--	79.6	53.3	66.5	95	31	495	4.73	1.60	7.23	7	.0
October----	69.5	43.1	56.3	90	20	241	3.47	1.05	5.40	5	.1
November---	52.7	30.6	41.7	76	5	20	1.62	.34	2.62	3	1.4
December---	39.2	20.5	29.9	66	-10	0	1.18	.50	1.72	3	7.0
Year-----	64.2	40.6	52.5	103	-20	3,656	35.80	28.91	42.37	64	26.7

[1]Recorded in the period 1951-74 at Bethany, Mo.

[2]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature (50° F) below which growth is minimal for the principal crops in the area.

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature[1]		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 20	April 27	May 14
2 years in 10 later than--	April 16	April 22	May 9
5 years in 10 later than--	April 8	April 14	April 30
First freezing temperature in fall:			
1 year in 10 earlier than--	October 18	October 3	September 23
2 years in 10 earlier than--	October 23	October 8	September 28
5 years in 10 earlier than--	October 31	October 18	October 7

[1]Recorded in the period 1951-74 at Bethany, Mo.

TABLE 3.--LENGTH OF GROWING SEASON

Probability	Daily minimum temperature during growing season[1]		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	187	167	141
8 years in 10	193	174	147
5 years in 10	205	187	159
2 years in 10	217	201	172
1 year in 10	224	208	178

[1]Recorded in the period 1951-74 at Bethany, Mo.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
AdC	Adair loam, 3 to 9 percent slopes	23,750	5.2
AeC2	Adair clay loam, 5 to 9 percent slopes, eroded	13,200	2.9
AmC	Armstrong loam, 5 to 9 percent slopes	7,000	1.5
AmD	Armstrong loam, 9 to 14 percent slopes	1,100	0.2
ArC3	Armstrong clay loam, 5 to 9 percent slopes, severely eroded	3,000	0.7
Co	Colo silty clay loam	2,800	0.6
GaC	Gara loam, 5 to 9 percent slopes	9,800	2.1
GaD	Gara loam, 9 to 14 percent slopes	11,800	2.6
GaE	Gara loam, 14 to 20 percent slopes	31,000	6.7
GbD3	Gara clay loam, 9 to 14 percent slopes, severely eroded	5,800	1.3
GeF	Gasconade flaggy silty clay loam, 14 to 30 percent slopes	3,550	0.8
GsB	Grundy silt loam, 2 to 5 percent slopes	43,000	9.3
GuB2	Grundy silty clay loam, 2 to 5 percent slopes, eroded	11,700	2.5
Ha	Haig silt loam	4,500	1.0
Hu	Humeston silt loam	8,700	1.9
LaC	Ladoga silt loam, 5 to 9 percent slopes	1,250	0.3
LgB	Lagonda silt loam, 2 to 5 percent slopes	3,000	0.7
LgC2	Lagonda silt loam, 5 to 9 percent slopes, eroded	34,000	7.4
LhC3	Lagonda silty clay loam, 5 to 9 percent slopes, severely eroded	2,300	0.5
LmC2	Lamoni clay loam, 5 to 9 percent slopes, eroded	27,750	6.0
LmC3	Lamoni clay loam, 5 to 9 percent slopes, severely eroded	5,500	1.2
No	Nodaway silt loam	28,500	6.2
PeB	Pershing silt loam, 2 to 5 percent slopes	4,900	1.1
PeC	Pershing silt loam, 5 to 9 percent slopes	7,000	1.5
PgC3	Pershing silty clay loam, 5 to 9 percent slopes, severely eroded	1,050	0.2
Pt	Pits, quarries	210	(1)
ShD	Shelby loam, 9 to 14 percent slopes	40,500	8.8
ShE	Shelby loam, 14 to 20 percent slopes	17,000	3.7
SkD3	Shelby clay loam, 9 to 14 percent slopes, severely eroded	28,000	6.1
SkE3	Shelby clay loam, 14 to 20 percent slopes, severely eroded	4,350	0.9
Wa	Wabash silty clay	6,700	1.5
WeB	Weller silt loam, 2 to 5 percent slopes	2,900	0.6
WeC	Weller silt loam, 5 to 9 percent slopes	780	0.2
WgC3	Weller silty clay loam, 5 to 9 percent slopes, severely eroded	710	0.2
Zo	Zook silty clay loam	15,200	3.3
Zz	Zook-Colo silty clay loams, channeled	48,000	10.2
	Water	500	0.1
	Total	460,800	100.0

[1]Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Estimates were made in 1976. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass	Smooth bromegrass
	Bu	Bu	Bu	Ton	AUM[1]	AUM[1]	AUM[1]
Adair:							
AdC	73	28	30	3.1	6.2	2.7	4.0
AeC2	60	21	25	2.7	5.4	2.3	3.5
Armstrong:							
AmC	72	25	30	3.3	5.4	2.3	3.3
AmD	63	22	26	2.8	4.6	2.0	3.1
ArC3	52	20	24	2.0	3.1	1.7	2.7
Colo:							
Co	104	40	41	4.2	---	4.2	5.5
Gara:							
GaC	87	33	35	3.7	7.4	3.3	5.1
GaD	78	30	32	3.3	6.6	2.7	4.7
GaE	---	---	---	2.5	5.0	1.7	3.3
GbD3	---	---	---	2.0	5.0	2.0	3.5
Gasconade:							
GeF	---	---	---	---	---	1.0	---
Grundy:							
GsB	98	38	40	4.4	9.0	---	8.8
GuB2	94	35	38	4.2	8.6	---	8.4
Haig:							
Ha	105	40	42	4.6	8.4	3.8	7.0
Humeston:							
Hu	88	33	36	3.7	---	3.3	5.0
Ladoga:							
LaC	86	37	36	3.8	9.0	4.0	7.5
Lagonda:							
LgB	90	34	38	4.0	7.0	---	8.8
LgC2	81	28	33	3.6	5.8	---	8.0
LhC3	74	28	31	3.4	5.0	---	7.0
Lamoni:							
LmC2	71	27	29	3.0	6.0	2.7	6.0
LmC3	61	23	25	2.6	5.0	2.1	5.0
Nodaway:							
No	98	37	41	4.6	9.0	4.0	6.5
Pershing:							
PeB	86	32	36	3.8	8.0	3.8	7.0
PeC	79	30	33	3.6	7.5	3.5	6.7
PgC3	70	25	28	3.1	6.5	3.3	5.5

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Bromegrass-alfalfa	Kentucky bluegrass	Smooth bromegrass
	Bu	Bu	Bu	Ton	AUM[1]	AUM[1]	AUM[1]
Shelby:							
ShD	84	32	35	3.5	7.0	3.3	5.0
ShE	69	26	29	2.9	5.8	2.3	4.1
SkD3	75	29	31	3.2	6.0	2.7	4.5
SkE3	---	---	---	2.6	---	1.7	4.0
Wabash:							
Wa	65	32	30	2.0	---	---	---
Weller:							
WeB	82	30	34	4.0	8.0	3.8	6.7
WeC	74	27	31	3.8	7.6	3.7	6.4
WgC3	65	23	26	2.8	6.0	2.7	4.7
Zook:							
Zo	80	30	34	4.0	---	4.0	4.0
[2]Zz:							
Zook part	65	23	26	3.5	---	---	---
Colo part	80	30	34	4.3	---	---	---

[1]Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
[2]This map unit is made up of two or more dominant kinds of soil. See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I	---	---	---	---	---
II	97,000	46,000	51,000	---	---
III	199,930	184,530	15,400	---	---
IV	70,460	70,460	---	---	---
V	48,000	---	48,000	---	---
VI	41,150	41,150	---	---	---
VII	3,550	---	---	3,550	---
VIII	---	---	---	---	---

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that the information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Plant competition	Potential productivity: Important trees	Potential productivity: Site index	Trees to plant
Armstrong:								
AmC, AmD, ArC3	4c	Slight	Slight	Moderate	Slight	White oak Northern red oak Black oak	55 55 ---	Eastern white pine, Scotch pine*, green ash.
Gara:								
GaC, GaD, GbD3	4o	Slight	Slight	Slight	Slight	White oak Northern red oak Black walnut	55 55 ---	Eastern white pine, black walnut, Scotch pine*, green ash.
GaE	4r	Moderate	Moderate	Slight	Slight	White oak Northern red oak Black walnut	55 55 ---	Eastern white pine, Scotch pine*, green ash, black walnut.
Gasconade:								
GeF	5d	Slight	Severe	Moderate	Slight	Eastern redcedar Northern red oak Black oak	30 --- ---	Eastern redcedar.
Grundy:								
GsB, GuB2	---	---	---	---	---	---	---	Eastern cottonwood, pin oak.
Ladoga:								
LaC	3o	Slight	Slight	Slight	Moderate	White oak Northern red oak Black walnut	65 65 ---	Eastern white pine, Scotch pine*, green ash, black walnut.
Nodaway:								
No	2o	Slight	Slight	Slight	Moderate	White oak Black walnut Eastern cottonwood	75 --- ---	Eastern white pine, Scotch pine*, black walnut, silver maple, pin oak, eastern cottonwood.
Pershing:								
PeB, PeC, PgC3	4c	Slight	Slight	Moderate	Slight	White oak Northern red oak Black oak	55 --- ---	Eastern white pine, Scotch pine*, green ash.
Wabash:								
Wa	4w	Slight	Moderate	Severe	Severe	Pin oak	75	Pin oak, eastern cottonwood.
Weller:								
WeB, WeC, WgC3	4c	Slight	Slight	Moderate	Slight	White oak Northern red oak Black oak	55 --- ---	Eastern white pine, Scotch pine*, green ash.

* Christmas tree species.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; the symbol > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Adair: AdC, AeC2	Silky dogwood	Autumn-olive, Amur honeysuckle.	Blue spruce, eastern redcedar.	Eastern white pine, red pine, Norway spruce, Scotch pine, green ash.	Silver maple, European alder.
Armstrong: AmC, AmD, ArC3	Silky dogwood	Autumn-olive, Amur honeysuckle.	Blue spruce, eastern redcedar.	Eastern white pine, red pine, Norway spruce, Scotch pine, green ash.	Silver maple, European alder.
Colo: Co	Silky dogwood	Redosier dogwood, medium purple willow, Russian-olive.	Hackberry, eastern redcedar.	Green ash, silver maple, American sycamore, pin oak.	Eastern cottonwood, European alder.
Gara: GaC, GaD, GaE, GbD3	Silky dogwood	Amur honeysuckle, autumn-olive.	Blue spruce, eastern redcedar.	Red pine, Scotch pine, green ash, Austrian pine.	Silver maple, eastern cottonwood, Eastern white pine.
Gasconade: GeF	Mockorange	American plum, Amur honeysuckle, autumn-olive, lilac, Tatarian honeysuckle.	Eastern redcedar, jack pine, Siberian elm, Amur maple.	Ailanthus	---
Grundy: GsB, GuB2	Silky dogwood	Amur honeysuckle, autumn-olive.	Eastern redcedar, blue spruce.	Pin oak, green ash, Norway spruce, eastern white pine.	European alder, silver maple, eastern cottonwood.
Haig: Ha	Silky dogwood	Amur honeysuckle, autumn-olive.	Eastern redcedar, hackberry, Norway spruce.	Green ash, American sycamore, pin oak.	Silver maple, eastern cottonwood, European alder.
Humeston: Hu	Silky dogwood	Amur honeysuckle, medium purple willow, autumn-olive.	American basswood, hackberry, eastern redcedar.	Pin oak, American sycamore, green ash.	Silver maple, European alder.
Ladoga: LaC	Mockorange	Amur honeysuckle, autumn-olive.	Blue spruce, eastern redcedar, jack pine.	Red pine, Scotch pine, green ash.	Eastern white pine, Norway spruce, silver maple.
Lagonda: LgB, LgC2, LhC3	Silky dogwood	Amur honeysuckle, autumn-olive.	Eastern redcedar, blue spruce.	Pin oak, green ash, eastern white pine, Norway spruce.	Eastern cottonwood, silver maple, European alder.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Lamoni:					
LmC2, LmC3	Silky dogwood	Amur honeysuckle, autumn-olive.	Blue spruce, eastern redcedar.	Eastern white pine, red pine, Norway spruce, Scotch pine, green ash.	Silver maple, eastern cottonwood.
Nodaway:					
No	Silky dogwood	Amur honeysuckle, autumn-olive.	American basswood, eastern redcedar.	Red pine, Norway spruce, Scotch pine, green ash.	Eastern white pine, silver maple, yellow-poplar.
Pershing:					
PeB, PeC, PgC3	Silky dogwood	Amur honeysuckle, autumn-olive.	Blue spruce, eastern redcedar.	Eastern white pine, red pine, Norway spruce, Scotch pine. green ash.	Silver maple, European alder.
Shelby:					
ShD, ShE, SkD3, SkE3	Silky dogwood	Autumn-olive, Amur honeysuckle.	Blue spruce, eastern redcedar.	Red pine, Scotch pine, green ash.	Eastern white pine, Norway spruce, eastern cottonwood, yellow-poplar.
Wabash:					
Wa	Silky dogwood	Medium purple willow, Tatarian honeysuckle, Amur honeysuckle, redosier dogwood.	Eastern redcedar, American basswood, Amur maple.	Green ash, pin oak.	Eastern cottonwood, European alder.
Weller:					
WeB, WeC, WgC3	Silky dogwood	Amur honeysuckle, autumn-olive.	Blue spruce, eastern redcedar.	Red pine, Scotch pine, green ash, silver maple, pin oak.	Eastern white pine, Norway spruce.
Zook:					
Zo	Silky dogwood	Amur honeysuckle, medium purple willow, redosier dogwood.	Eastern redcedar, American basswood.	Green ash, silver maple, American sycamore, pin oak.	Eastern cottonwood, European alder.
[1]Zz:					
Zook part	Silky dogwood	Amur honeysuckle, medium purple willow, redosier dogwood.	Eastern redcedar, American basswood.	Green ash, silver maple, American sycamore, pin oak.	Eastern cottonwood, European alder.
Colo part	Silky dogwood	Redosier dogwood, medium purple willow, Russian-olive.	Hackberry, eastern redcedar.	Green ash, silver maple, American American sycamore, pin oak.	Eastern cottonwood, European alder.

[1]This map unit is made up of two or more dominant kinds of soil. See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "moderate," and "severe"]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Adair:					
AdC, AeC2	Severe: wetness, too clayey.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength, frost action.
Armstrong:					
AmC, ArC3	Severe: wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, frost action.
AmD	Severe: wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, frost action.
Colo:					
Co	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, low strength, frost action.
Gara:					
GaC	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Severe: low strength.
GaD, GbD3	Moderate: slope, too clayey.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.
GaE	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Gasconade:					
GeF	Severe: depth to rock, large stones, slope.	Severe: depth to rock, large stones, slope.	Severe: depth to rock, large stones, slope.	Severe: depth to rock, large stones, slope.	Severe: depth to rock, large stones, slope.
Grundy:					
GsB, GuB2	Severe: wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Haig:					
Ha	Severe: wetness, too clayey.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, wetness, low strength.
Humeston:					
Hu	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: wetness, low strength, shrink-swell.
Ladoga:					
LaC	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: frost action, low strength.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Lagonda:					
LgB, LgC2, LhC3--	Severe: wetness.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, frost action, low strength.
Lamoni:					
LmC2, LmC3--------	Severe: wetness, too clayey.	Severe: shrink-swell, low strength, wetness.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, wetness, low strength.
Nodaway:					
No----------------	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.
Pershing:					
PeB, PeC, PgC3---	Moderate: wetness.	Severe: shrink-swell, low strength.	Severe: shrink-swell, wetness, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, frost action.
Shelby:					
ShD, SkD3---------	Moderate: slope, too clayey.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.
ShE, SkE3---------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Wabash:					
Wa----------------	Severe: wetness, floods, too clayey.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.
Weller:					
WeB, WeC, WgC3---	Severe: wetness, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, frost action, low strength.
Zook:					
Zo----------------	Severe: wetness, floods, too clayey.	Severe: floods, low strength, shrink-swell.	Severe: floods, low strength, shrink-swell.	Severe: floods, low strength, shrink-swell.	Severe: floods, low strength, shrink-swell.
[1]Zz:					
Zook part-------	Severe: wetness, floods, too clayey.	Severe: floods, low strength, shrink-swell.	Severe: floods, low strength, shrink-swell.	Severe: floods, low strength, shrink-swell.	Severe: floods, low strength, shrink-swell.
Colo part-------	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, low strength, frost action.

[1]This map unit is made up of two or more dominant kinds of soil. See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 10.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and "poor"]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Adair:					
AdC	Severe: percs slowly, wetness.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: thin layer.
AeC2	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: thin layer.
Armstrong:					
AmC, AmD, ArC3	Severe: percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: area reclaim.
Colo:					
Co	Severe: percs slowly, wetness, floods.	Severe: excess humus, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Gara:					
GaC	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
GaD, GbD3	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
GaE	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope.	Poor: slope, area reclaim.
Gasconade:					
GeF	Severe: depth to rock, large stones, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, large stones, seepage.	Severe: seepage, slope.	Poor: large stones, thin layer, too clayey.
Grundy:					
GsB, GuB2	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: too clayey, wetness.	Moderate: wetness.	Fair: too clayey.
Haig:					
Ha	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey.
Humeston:					
Hu	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Ladoga:					
LaC	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Lagonda:					
LgB	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey.
LgC2, LhC3	Severe: percs slowly, wetness.	Severe: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Lamoni:					
LmC2, LmC3	Severe: percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: area reclaim, too clayey.
Nodaway:					
No	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Pershing:					
PeB	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: too clayey, wetness.	Moderate: wetness.	Fair: too clayey.
PeC, PgC3	Severe: percs slowly, wetness.	Severe: slope.	Moderate: too clayey, wetness.	Moderate: wetness.	Fair: too clayey.
Shelby:					
ShD, SkD3	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
ShE, SkE3	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope.	Poor: slope.
Wabash:					
Wa	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
Weller:					
WeB	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
WeC, WgC3	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
Zook:					
Zo	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey.
[1]Zz:					
Zook part	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey.
Colo part	Severe: percs slowly, wetness, floods.	Severe: excess humus, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.

[1]This map unit is made up of two or more dominant kinds of soil. See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 11.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor"]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Adair:				
AdC	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
AeC2	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Armstrong:				
AmC, AmD, ArC3	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
Colo:				
Co	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Gara:				
GaC	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
GaD	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
GaE	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
GbD3	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
Gasconade:				
GeF	Poor: thin layer, large stones, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, large stones, area reclaim.
Grundy:				
GsB, GuB2	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Haig:				
Ha	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Humeston:				
Hu	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
Ladoga:				
LaC	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Lagonda:				
LgB, LgC2, LhC3	Poor: shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Lamoni:				
LmC2, LmC3	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
Nodaway:				
No	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Pershing:				
PeB, PeC, PgC3	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim, thin layer.
Shelby:				
ShD	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
ShE, SkE3	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Severe: slope.
SkD3	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
Wabash:				
Wa	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Weller:				
WeB, WeC, WgC3	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Zook:				
Zo	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, wetness.
[1]Zz:				
Zook part	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, wetness.
Colo part	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.

[1]This map unit is made up of two or more dominant kinds of soil. See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 12.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Adair:						
AdC, AeC2	Slope	Shrink-swell, erodes easily.	Percs slowly	Erodes easily, percs slowly.	Complex slope	Percs slowly.
Armstrong:						
AmC, AmD, ArC3	Slope	Shrink-swell, erodes easily.	Percs slowly	Erodes easily, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Colo:						
Co	Favorable	Compressible, low strength, hard to pack.	Floods, wetness.	Floods, wetness.	Not needed	Wetness.
Gara:						
GaC, GaD, GaE, GbD3	Slope	Shrink-swell	Not needed	Erodes easily, slope.	Erodes easily, slope.	Erodes easily, slope.
Gasconade:						
GeF	Depth to rock, seepage.	Large stones, thin layer, seepage.	Not needed	Droughty, seepage, rooting depth.	Depth to rock, large stones.	Large stones, rooting depth.
Grundy:						
GsB, GuB2	Favorable	Low strength, shrink-swell.	Percs slowly, wetness.	Slow intake, percs slowly.	Percs slowly, wetness.	Percs slowly, wetness.
Haig:						
Ha	Favorable	Compressible, low strength, shrink-swell.	Percs slowly	Wetness	Not needed	Percs slowly.
Humeston:						
Hu	Favorable	Low strength, shrink-swell.	Percs slowly, wetness.	Slow intake	Percs slowly, wetness.	Percs slowly, wetness.
Ladoga:						
LaC	Favorable	Compressible, low strength, shrink-swell.	Not needed	Erodes easily	Favorable	Favorable.
Lagonda:						
LgB, LgC2, LhC3	Favorable	Shrink-swell	Not needed	Slow intake, wetness.	Percs slowly, wetness.	Percs slowly, wetness, erodes easily.
Lamoni:						
LmC2, LmC3	Slope	Shrink-swell, erodes easily, low strength.	Percs slowly, slope.	Erodes easily, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Nodaway:						
No	Seepage	Low strength	Floods	Floods	Not needed	Not needed.
Pershing:						
PeB, PeC, PgC3	Favorable	Compressible, low strength, shrink-swell.	Percs slowly, slope.	Wetness, slow intake.	Percs slowly	Favorable.
Shelby:						
ShD, ShE, SkD3, SkE3	Slope	Low strength, shrink-swell.	Not needed	Slow intake, slope, erodes easily.	Erodes easily, slope.	Erodes easily, slope.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Wabash:						
Wa	Favorable	Shrink-swell, compressible, low strength.	Floods, percs slowly, wetness.	Slow intake, wetness, floods.	Percs slowly, wetness.	Percs slowly, wetness.
Weller:						
WeB, WeC, WgC3	Favorable	Compressible, low strength, shrink-swell.	Not needed	Erodes easily, slow intake.	Percs slowly	Percs slowly, erodes easily.
Zook:						
Zo	Favorable	Shrink-swell, low strength, hard to pack.	Floods, wetness, percs slowly.	Floods, wetness, percs slowly.	Not needed	Wetness.
[1]Zz:						
Zook part	Favorable	Shrink-swell, low strength, hard to pack.	Floods, wetness, percs slowly.	Floods, wetness, percs slowly.	Not needed	Wetness.
Colo part	Favorable	Compressible, low strength, hard to pack.	Floods, wetness.	Floods, wetness.	Not needed	Wetness.

[1]This map unit is made up of two or more dominant kinds of soil. See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 13.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Adair:				
AdC	Moderate: percs slowly.	Moderate: wetness.	Severe: slope.	Moderate: wetness.
AeC2	Moderate: percs slowly, too clayey.	Moderate: wetness, too clayey.	Severe: slope.	Moderate: wetness, too clayey.
Armstrong:				
AmC, ArC3	Moderate: percs slowly, wetness.	Moderate: wetness.	Severe: slope.	Moderate: wetness.
AmD	Moderate: percs slowly, wetness, slope.	Moderate: wetness, slope.	Severe: slope.	Moderate: wetness.
Colo:				
Co	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
Gara:				
GaC	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
GaD	Moderate: percs slowly, slope.	Moderate: slope.	Severe: slope.	Slight.
GaE	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
GbD3	Moderate: slope, percs slowly, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.
Gasconade:				
GeF	Severe: large stones, slope.	Severe: large stones, slope.	Severe: depth to rock, large stones, slope.	Severe: large stones.
Grundy:				
GsB, GuB2	Moderate: percs slowly, wetness.	Moderate: wetness.	Moderate: percs slowly, wetness.	Moderate: wetness.
Haig:				
Ha	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.
Humeston:				
Hu	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Ladoga:				
LaC	Moderate: percs slowly.	Slight	Severe: slope.	Slight.

TABLE 13.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Lagonda:				
LgB	Moderate: percs slowly, wetness.	Moderate: wetness.	Moderate: percs slowly, wetness.	Moderate: wetness.
LgC2, LhC3	Moderate: percs slowly, wetness.	Moderate: wetness.	Severe: slope.	Moderate: wetness.
Lamoni:				
LmC2, LmC3	Severe: percs slowly.	Moderate: wetness, too clayey.	Severe: percs slowly, slope.	Moderate: wetness, too clayey.
Nodaway:				
No	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
Pershing:				
PeB	Moderate: percs slowly, wetness.	Moderate: wetness.	Moderate: wetness, percs slowly.	Moderate: wetness.
PeC, PgC3	Moderate: percs slowly, wetness.	Moderate: wetness.	Severe: slope.	Moderate: wetness.
Shelby:				
ShD	Moderate: percs slowly, slope.	Moderate: slope.	Severe: slope.	Slight.
ShE	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
SkD3	Moderate: percs slowly, too clayey, slope.	Moderate: too clayey, slope.	Severe: slope.	Moderate: too clayey.
SkE3	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.
Wabash:				
Wa	Severe: floods, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.
Weller:				
WeB	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: percs slowly, wetness, slope.	Slight.
WeC, WgC3	Moderate: wetness, percs slowly.	Moderate: wetness.	Severe: slope.	Slight.
Zook:				
Zo	Severe: wetness, floods.	Moderate: wetness, too clayey, floods.	Severe: wetness, floods.	Moderate: too clayey, wetness.
[1]Zz:				
Zook part	Severe: wetness, floods.	Moderate: wetness, too clayey, floods.	Severe: wetness, floods.	Moderate: too clayey, wetness.

See footnote at end of table.

TABLE 13.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Zook:				
Colo part	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness.

[1]This map unit is made up of two or more dominant kinds of soil. See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 14.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor"]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Adair:										
AdC, AeC2	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor
Armstrong:										
AmC, AmD, ArC3	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor
Colo:										
Co	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good
Gara:										
GaC, GaD, GbD3	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor
GaE	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
Gasconade:										
GeF	Very poor	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor
Grundy:										
GsB, GuB2	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair
Haig:										
Ha	Good	Fair	Good	Fair	Poor	Good	Good	Good	Fair	Good
Humeston:										
Hu	Good	Fair	Good	Fair	Poor	Good	Good	Good	Fair	Good
Ladoga:										
LaC	Fair	Good	Good	Good	Good	Very poor	Poor	Good	Good	Very poor
Lagonda:										
LgB, LgC2, LhC3	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor

TABLE 14.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Lamoni:										
LmC2, LmC3	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor
Nodaway:										
No	Good	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor
Pershing:										
PeB	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor
PeC, PgC3	Fair	Good	Good	Good	Good	Very poor	Poor	Good	Good	Very poor
Shelby:										
ShD, SkD3	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor
ShE, SkE3	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
Wabash:										
Wa	Poor	Poor	Fair	Poor	Poor	Poor	Good	Poor	Poor	Fair
Weller:										
WeB	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor
WeC, WgC3	Fair	Good	Good	Good	Good	Very poor	Poor	Good	Good	Very poor
Zook:										
Zo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good
[1]Zz:										
Zook part	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good
Colo part	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good

[1]This map unit is made up of two or more dominant kinds of soil. See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Adair:											
AdC	0-12	Loam	CL, CL-ML	A-6, A-4	0	95-100	95-100	90-100	85-100	20-35	5-15
	12-36	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	41-55	20-30
	36-73	Clay loam	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-45	15-25
AeC2	0-12	Clay loam	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	11-20
	12-33	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	41-55	20-30
	33-77	Clay loam	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-45	15-25
Armstrong:											
AmC, AmD	0-6	Loam	CL, CL-ML	A-6, A-4	0	95-100	80-95	75-90	55-80	20-40	5-20
	6-32	Clay loam, clay, silty clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	45-60	20-30
	32-60	Clay loam	CL	A-6	0	95-100	80-95	70-90	55-80	30-40	15-20
ArC3	0-7	Clay loam	CL, CL-ML	A-6, A-4	0	95-100	80-95	75-90	55-80	20-40	5-20
	7-28	Clay loam, clay, silty clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	45-60	20-30
	28-60	Clay loam	CL	A-6	0	95-100	80-95	70-90	55-80	30-40	15-20
Colo:											
Co	0-24	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	90-100	90-100	40-60	15-30
	24-62	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	90-100	90-100	40-55	15-30
Gara:											
GaC, GaD, GaE	0-7	Loam	CL, CL-ML	A-4, A-6	0	85-95	80-90	70-80	55-70	20-30	5-15
	7-41	Clay loam	CL	A-6	0	85-95	80-90	70-85	55-75	30-40	15-25
	41-68	Loam, clay loam	CL	A-6, A-7	0	85-95	80-90	70-85	55-75	35-45	15-25
GbD3	0-7	Clay loam	CL	A-6, A-7	0	85-95	80-90	70-85	55-75	35-45	15-25
	7-38	Clay loam	CL	A-6	0	85-95	80-90	70-85	55-75	30-40	15-25
	38-68	Loam, clay loam	CL	A-6, A-7	0	85-95	80-90	70-85	55-75	35-45	15-25
Gasconade:											
GeF	0-6	Flaggy silty clay loam.	CL	A-6	20-70	70-85	70-85	60-75	55-65	30-40	15-25
	6-13	Flaggy silty clay, flaggy clay.	GC	A-2-7	20-70	40-50	40-50	30-40	20-35	55-65	35-45
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Grundy:											
GsB	0-11	Silt loam	CL, ML	A-6, A-7, A-4	0	100	100	95-100	90-100	30-50	5-25
	11-14	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	45-55	30-40
	14-38	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	50-70	30-45
	38-72	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-55	30-40
GuB2	0-7	Silty clay loam	CL, ML	A-6, A-7, A-4	0	100	100	95-100	90-100	30-50	5-25
	7-37	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	50-70	30-45
	37-74	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-55	30-40

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Haig:											
Ha	0-10	Silt loam	CL, OL	A-6, A-7	0	100	100	95-100	90-100	35-45	10-20
	10-16	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	40-55	20-30
	16-31	Silty clay	CH	A-7	0	100	100	95-100	90-100	50-65	30-40
	31-84	Silty clay loam	CL, CH	A-7, A-6	0	100	100	95-100	90-100	35-55	20-30
Humeston:											
Hu	0-17	Silt loam	CL, CL-ML	A-6, A-4	0	100	100	95-100	95-100	25-40	5-20
	17-23	Silt loam	CL, CL-ML	A-7, A-6, A-4	0	100	100	95-100	95-100	25-45	5-20
	23-67	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	45-55	25-35
Ladoga:											
LaC	0-7	Silt loam	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	7-62	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	41-55	25-35
	62-84	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
Lagonda:											
LgB, LgC2	0-7	Silt loam	CL, ML	A-4, A-6, A-7	0	100	100	95-100	90-100	30-45	5-15
	7-25	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	95-100	50-70	35-45
	25-61	Silty clay loam, silty clay, clay loam.	CL, CH	A-7	0	95-100	90-100	80-95	75-90	40-55	25-40
	61-72	Clay loam, clay	CL, CH	A-7	0	95-100	90-100	90-100	75-90	40-65	25-40
LhC3	0-7	Silty clay loam	CL, ML	A-4, A-6, A-7	0	100	100	95-100	90-100	30-45	5-15
	7-22	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	95-100	50-70	35-45
	22-56	Silty clay loam, silty clay, clay loam.	CL, CH	A-7	0	95-100	90-100	80-95	75-90	40-55	25-40
	56-67	Clay loam, clay	CL, CH	A-7	0	95-100	90-100	90-100	75-90	40-65	25-40
Lamoni:											
LmC2, LmC3	0-12	Clay loam	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	12-31	Clay loam, clay	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	31-66	Clay loam	CL	A-6, A-7	0	95-100	95-100	70-90	55-85	35-50	15-30
Nodaway:											
No	0-75	Silt loam	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
Pershing:											
PeB, PeC	0-6	Silt loam	CL	A-6	0	100	100	100	95-100	30-40	11-20
	6-37	Silty clay loam, silty clay.	CH	A-7	0	100	100	100	95-100	50-65	30-40
	37-70	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-55	25-35
PgC3	0-6	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	6-37	Silty clay loam, silty clay.	CH	A-7	0	100	100	100	95-100	50-65	30-40
	37-70	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-55	25-35
Shelby:											
ShD, ShE	0-12	Loam	CL	A-6	0	90-100	85-98	75-90	55-70	30-40	11-20
	12-30	Clay loam	CL	A-6, A-7	0	90-100	85-98	75-90	55-70	30-40	15-25
	30-66	Clay loam	CL	A-6, A-7	0	90-100	85-98	75-90	55-70	30-40	15-25
SkD3, SkE3	0-7	Clay loam	CL	A-6	0	90-100	85-98	75-90	55-70	30-40	11-20
	7-25	Clay loam	CL	A-6, A-7	0	90-100	85-98	75-90	55-70	30-40	15-25
	25-60	Clay loam	CL	A-6, A-7	0	90-100	85-98	75-90	55-70	30-40	15-25

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Wabash:											
Wa----------------	0-8	Silty clay------	CH	A-7	0	100	100	100	95-100	50-75	30-55
	8-83	Silty clay, clay	CH	A-7	0	100	100	100	95-100	52-78	30-55
Weller:											
WeB, WeC----------	0-8	Silt loam--------	ML, CL	A-6, A-4	0	100	100	100	95-100	30-40	5-15
	8-64	Silty clay loam, silty clay.	CH	A-7	0	100	100	100	95-100	50-65	30-40
	64-89	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-55	20-30
WgC3--------------	0-8	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	8-58	Silty clay loam, silty clay.	CH	A-7	0	100	100	100	95-100	50-65	30-40
	58-83	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-55	20-30
Zook:											
Zo----------------	0-17	Silty clay loam	MH, CH, CL, OL	A-7	0	100	100	95-100	95-100	45-70	20-40
	17-85	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
[1]Zz:											
Zook part--------	0-17	Silty clay loam	MH, CH, CL, OL	A-7	0	100	100	95-100	95-100	45-70	20-40
	17-85	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
Colo part--------	0-24	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	90-100	90-100	40-60	15-30
	24-62	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	90-100	90-100	40-55	15-30

[1]This map unit is made up of two or more dominant kinds of soil. See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply to the surface layer. Dashes indicate that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm						
Adair:											
AdC	0-12	0.6-2.0	0.20-0.22	5.6-6.5	<2	Moderate	High	Moderate	0.32	3	6
	12-36	0.06-0.2	0.13-0.16	5.1-6.5	<2	High	High	Moderate	0.32		
	36-73	0.2-0.6	0.14-0.16	5.6-6.5	<2	Moderate	High	Moderate	0.32		
AeC2	0-12	0.2-0.6	0.17-0.19	5.6-6.5	<2	Moderate	High	Moderate	0.32	3	6
	12-33	0.06-0.2	0.13-0.16	5.1-6.5	<2	High	High	Moderate	0.32		
	33-77	0.2-0.6	0.14-0.16	5.6-6.5	<2	Moderate	High	Moderate	0.32		
Armstrong:											
AmC, AmD, ArC3	0-6	0.6-2.0	0.20-0.22	5.6-6.5	<2	Moderate	High	Moderate	0.32	3-2	6
	6-32	0.06-0.2	0.11-0.16	5.1-6.5	<2	High	High	Moderate	0.32		
	32-60	0.2-0.6	0.14-0.16	5.1-6.5	<2	Moderate	High	Moderate	0.32		
Colo:											
Co	0-24	0.2-0.6	0.21-0.23	5.6-7.3	<2	High	High	Moderate	0.28	5	7
	24-62	0.2-0.6	0.18-0.20	6.1-7.3	<2	High	High	Moderate	0.28		
Gara:											
GaC, GaD, GaE	0-7	0.6-2.0	0.20-0.22	5.6-6.0	<2	Moderate	Moderate	Moderate	0.28	5	6
	7-41	0.2-0.6	0.16-0.18	5.1-6.5	<2	Moderate	Moderate	Moderate	0.28		
	41-68	0.2-0.6	0.16-0.18	6.6-7.8	<2	Moderate	Moderate	Moderate	0.37		
GbD3	0-7	0.2-0.6	0.16-0.18	5.6-6.0	<2	Moderate	Moderate	Moderate	0.28	4	6
	7-38	0.2-0.6	0.16-0.18	5.1-6.5	<2	Moderate	Moderate	Moderate	0.28		
	38-68	0.2-0.6	0.16-0.18	6.6-7.8	<2	Moderate	Moderate	Moderate	0.37		
Gasconade:											
GeF	0-6	0.6-2.0	0.10-0.12	6.6-7.8	<2	Moderate	High	Low	0.20	2	8
	6-13	0.2-0.6	0.05-0.07	6.6-7.8	<2	Moderate	High	Low	0.20		
	13	---	---	---	---	---	---	---	---		
Grundy:											
GsB, GuB2	0-11	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	High	Low	0.37	3	6
	11-14	0.2-0.6	0.18-0.20	5.6-6.0	<2	High	High	Low	0.37		
	14-38	0.06-0.2	0.11-0.13	5.1-6.5	<2	High	High	Moderate	0.37		
	38-72	0.06-0.2	0.18-0.20	5.6-7.3	<2	High	High	Low	0.37		
Haig:											
Ha	0-10	0.6-2.0	0.22-0.24	5.6-6.5	<2	Moderate	High	Moderate	0.37	3	6
	10-16	0.6-2.0	0.21-0.23	5.1-6.0	<2	High	High	Moderate	0.37		
	16-31	<0.2	0.12-0.14	5.1-6.0	<2	High	High	Moderate	0.37		
	31-84	0.2-0.6	0.18-0.20	6.1-7.3	<2	High	High	Low	0.37		
Humeston:											
Hu	0-17	0.2-2.0	0.21-0.23	5.1-6.0	<2	Moderate	High	Moderate	0.32	4	7
	17-23	0.2-2.0	0.20-0.22	4.5-6.0	<2	Moderate	High	Moderate	0.32		
	23-67	<0.06	0.13-0.15	4.5-6.5	<2	High	High	Moderate	0.32		
Ladoga:											
LaC	0-7	0.6-2.0	0.22-0.24	6.1-6.5	<2	Low	Moderate	Low	0.32	4	6
	7-62	0.2-0.6	0.18-0.20	5.1-6.0	<2	Moderate	Moderate	Moderate	0.43		
	62-84	0.2-0.6	0.18-0.20	5.1-6.5	<2	Moderate	Moderate	Moderate	0.43		
Lagonda:											
LgB, LgC2, LhC3	0-7	0.6-2.0	0.21-0.24	5.6-6.5	<2	Moderate	Moderate	Low	0.37	3-2	6
	7-25	0.06-0.2	0.13-0.18	5.6-7.3	<2	High	High	Low	0.37		
	25-61	0.06-0.2	0.10-0.18	6.6-7.8	<2	High	High	Low	0.37		
	61-72	0.06-0.2	0.08-0.16	7.9-8.4	<2	High	High	Low	0.37		
Lamoni:											
LmC2, LmC3	0-12	0.2-0.6	0.17-0.21	5.1-6.5	<2	Moderate	High	Moderate	0.32	3-2	7
	12-31	<0.2	0.13-0.17	5.1-6.5	<2	High	High	Moderate	0.32		
	31-66	0.06-0.2	0.14-0.18	6.1-6.5	<2	High	High	Moderate	0.32		

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodi-bility group
							Uncoated steel	Concrete	K	T	
	In	In/hr	In/in	pH	Mmhos/cm						
Nodaway:											
No----------------	0-75	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate--	Moderate-	Low-------	0.37	5	7
Pershing:											
PeB, PeC-----------	0-6	0.6-2.0	0.22-0.24	4.5-6.5	<2	Low--------	High------	Moderate-	0.37	3	6
	6-37	0.06-0.2	0.18-0.20	5.1-6.0	<2	High-------	High------	Moderate-	0.37		
	37-70	0.2-0.6	0.18-0.20	5.1-6.0	<2	Moderate--	High------	Moderate-	0.37		
PgC3---------------	0-6	0.2-0.6	0.22-0.24	4.5-6.5	<2	Moderate--	High------	Moderate-	0.37	2	7
	6-37	0.06-0.2	0.18-0.20	5.1-6.0	<2	High-------	High------	Moderate-	0.37		
	37-70	0.2-0.6	0.18-0.20	5.1-6.0	<2	Moderate--	High------	Moderate-	0.37		
Shelby:											
ShD, ShE, SkD3, SkE3---------------	0-12	0.6-2.0	0.20-0.22	5.6-6.5	<2	Moderate--	Moderate-	Moderate-	0.28	4-3	6
	12-30	0.2-0.6	0.16-0.18	5.6-7.8	<2	Moderate--	Moderate-	Moderate-	0.28		
	30-66	0.2-0.6	0.16-0.18	6.6-8.4	<2	Moderate--	Moderate-	Moderate-	0.37		
Wabash:											
Wa-----------------	0-8	<0.06	0.12-0.14	5.6-7.3	<2	Very high-	High------	Moderate-	0.28	5	4
	8-83	<0.06	0.08-0.12	5.6-7.8	<2	Very high-	High------	Moderate-	0.28		
Weller:											
WeB, WeC-----------	0-8	0.6-2.0	0.22-0.24	4.5-6.0	<2	Low--------	High------	High------	0.43	3	6
	8-64	0.06-0.2	0.12-0.18	4.5-6.0	<2	High-------	High------	High------	0.43		
	64-89	0.2-0.6	0.18-0.20	5.1-6.0	<2	High-------	High------	Moderate-	0.43		
WgC3---------------	0-8	0.2-0.6	0.22-0.24	4.5-6.0	<2	High-------	High------	High------	0.43	2	7
	8-58	0.06-0.2	0.12-0.18	4.5-6.0	<2	High-------	High------	High------	0.43		
	58-83	0.2-0.6	0.18-0.20	5.1-6.0	<2	High-------	High------	Moderate-	0.43		
Zook:											
Zo-----------------	0-17	0.2-0.6	0.21-0.23	5.6-7.8	<2	High-------	High------	Moderate-	0.28	5	7
	17-85	0.06-0.2	0.11-0.13	5.6-7.8	<2	High-------	High------	Moderate-	0.28		
[1]Zz:											
Zook part--------	0-17	0.2-0.6	0.21-0.23	5.6-7.8	<2	High-------	High------	Moderate-	0.28	5	7
	17-85	0.06-0.2	0.11-0.13	5.6-7.8	<2	High-------	High------	Moderate-	0.28		
Colo part--------	0-24	0.2-0.6	0.21-0.23	5.6-7.3	<2	High-------	High------	Moderate-	0.28	5	7
	24-62	0.2-0.6	0.18-0.20	6.1-7.3	<2	High-------	High------	Moderate-	0.28		

[1]This map unit is made up of two or more dominant kinds of soil. See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "brief," "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	
					Ft			In		
Adair: AdC, AeC2	D	None	---	---	1.0-3.0	Perched	Nov-Mar	>60	---	High.
Armstrong: AmC, AmD, ArC3	D	None	---	---	1.0-3.0	Perched	Nov-Mar	>60	---	High.
Colo: Co	B/D	Common	Brief	Mar-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High.
Gara: GaC, GaD, GaE, GbD3	C	None	---	---	>6.0	---	---	>60	---	Moderate.
Gasconade: GeF	D	None	---	---	>6.0	---	---	10-20	Hard	Moderate.
Grundy: GsB, GuB2	C	None	---	---	1.0-3.0	Perched	Mar-May	>60	---	Moderate.
Haig: Ha	C/D	None	---	---	0-3.0	Perched	Apr-Jul	>60	---	High.
Humeston: Hu	C	Rare	---	---	1.0-3.0	Apparent	Nov-Apr	>60	---	High.
Ladoga: LaC	B	None	---	---	>6.0	---	---	>60	---	High.
Lagonda: LgB, LgC2, LhC3	C	None	---	---	1.5-3.0	Perched	Nov-Apr	>60	---	High.
Lamoni: LmC2, LmC3	D	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	Moderate.
Nodaway: No	B	Common	Brief	Feb-Nov	>6.0	---	---	>60	---	High.
Pershing: PeB, PeC, PgC3	C	None	---	---	2.0-4.0	Perched	Apr-Jul	>60	---	High.
Shelby: ShD, ShE, SkD3, SkE3	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Wabash: Wa	D	Common	Brief to long.	Nov-May	0-1.0	Perched	Nov-May	>60	---	Moderate.
Weller: WeB, WeC, WgC3	C	None	---	---	2.0-4.0	Perched	Apr-Jul	>60	---	High.
Zook: Zo	C/D	Common	Brief	Mar-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High.
[1]Zz: Zook part	C/D	Common	Brief	Mar-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High.
Colo part	B/D	Common	Brief	Mar-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High.

[1]This map unit is made up of two or more kinds of soil. See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
*Adair	Fine, montmorillonitic, mesic Aquic Argiudolls
*Armstrong	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Gara	Fine-loamy, mixed, mesic Mollic Hapludalfs
Gasconade	Clayey-skeletal, mixed, mesic Lithic Hapludolls
Grundy	Fine, montmorillonitic, mesic Aquic Argiudolls
Haig	Fine, montmorillonitic, mesic Typic Argiaquolls
Humeston	Fine, montmorillonitic, mesic Argiaquic Argialbolls
*Ladoga	Fine, montmorillonitic, mesic Mollic Hapludalfs
*Lagonda	Fine, montmorillonitic, mesic Aquic Argiudolls
*Lamoni	Fine, montmorillonitic, mesic Aquic Argiudolls
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
*Pershing	Fine, montmorillonitic, mesic Udollic Ochraqualfs
Shelby	Fine-loamy, mixed, mesic Typic Argiudolls
Wabash	Fine, montmorillonitic, mesic Vertic Haplaquolls
Weller	Fine, montmorillonitic, mesic Aquic Hapludalfs
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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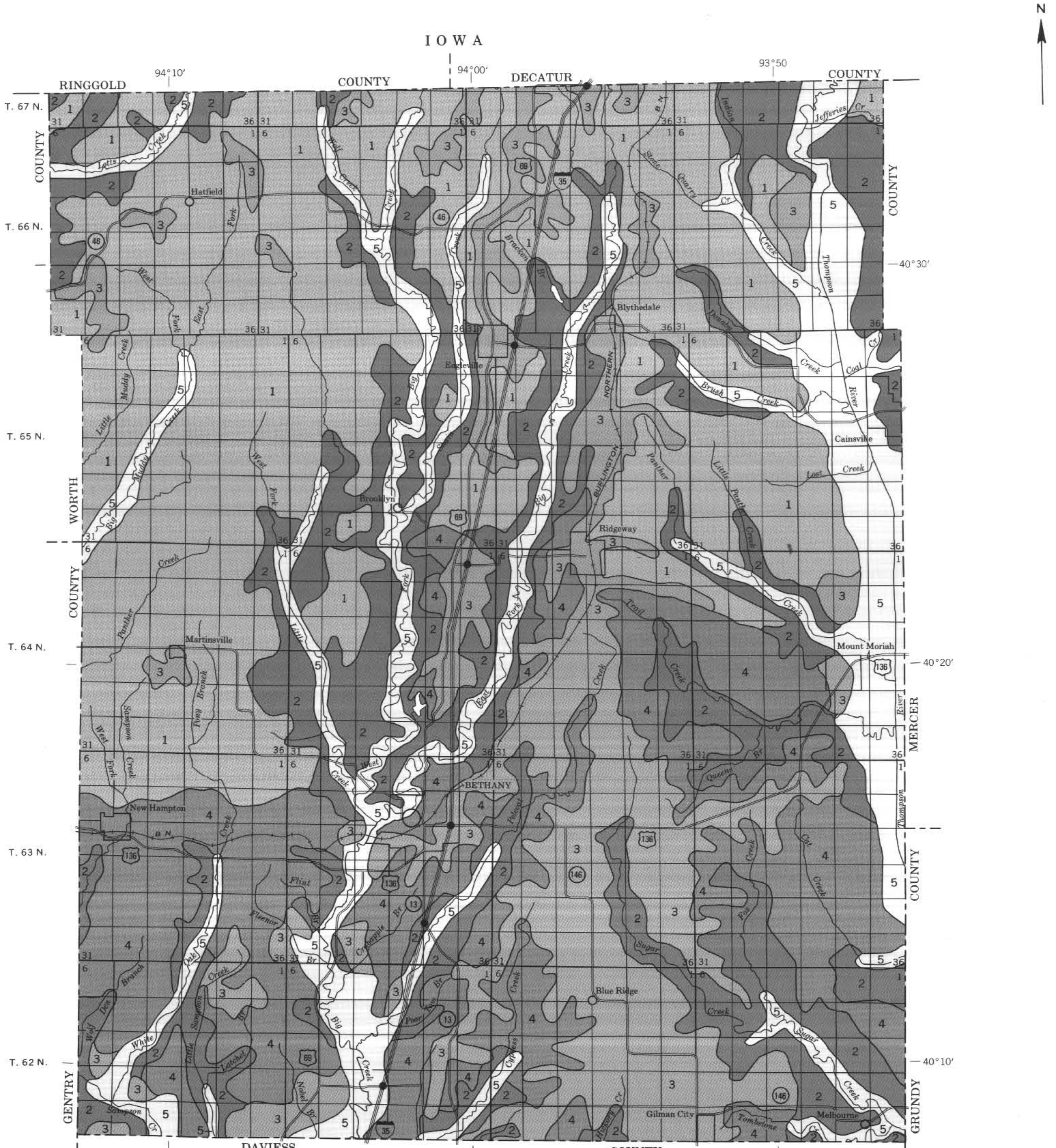


SOIL LEGEND

1	Shelby–Adair–Zook: Deep, nearly level to moderately steep, moderately well drained to poorly drained soils that formed in glacial till and alluvial sediment
2	Gara–Pershing–Armstrong: Deep, gently sloping to moderately steep, moderately well drained and somewhat poorly drained soils that formed in loess and glacial till
3	Grundy–Lagonda: Deep, gently sloping and moderately sloping, somewhat poorly drained soils that formed in loess and in thin loess over glacial till
4	Lamoni–Shelby–Zook: Deep, nearly level to strongly sloping, moderately well drained to poorly drained soils that formed in glacial till and alluvial sediment
5	Nodaway–Zook: Deep, nearly level, moderately well drained and poorly drained soils that formed in alluvial sediment

Compiled 1977

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MISSOURI AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

HARRISON COUNTY, MISSOURI

Scale 1:190,080

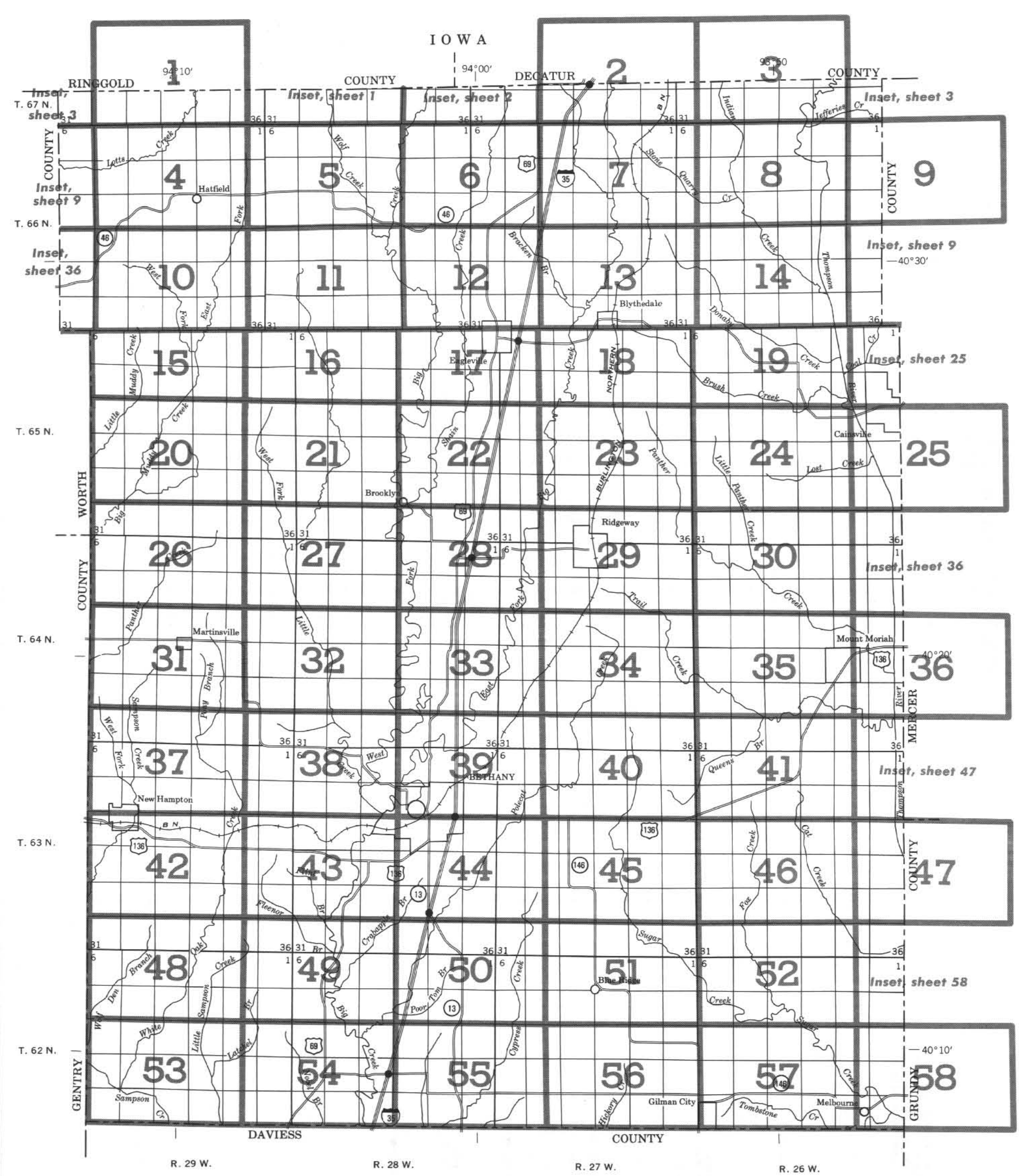
1 0 1 2 3 4 Miles

Index Map Welcome Page Manuscript

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



INDEX TO MAP SHEETS

HARRISON COUNTY, MISSOURI

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

General Soil Map

Welcome Page

Manuscript

SOIL LEGEND

The first capital letter is the initial one of the soil name. The lower case letter that follows separates mapping units having names that begin with the same letter except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for soils with a slope range of 0 to 2 percent or they are for miscellaneous areas with a considerable range of slope. A final number of 2 or 3 in the symbol indicates that the soil is eroded or severely eroded respectively.

SYMBOL	NAME
AdC	Adair loam, 3 to 9 percent slopes
AeC2	Adair clay loam, 5 to 9 percent slopes, eroded
AmC	Armstrong loam, 5 to 9 percent slopes
AmD	Armstrong loam, 9 to 14 percent slopes
ArC3	Armstrong clay loam, 5 to 9 percent slopes, severely eroded
Co	Colo silty clay loam
GaC	Gara loam, 5 to 9 percent slopes
GaD	Gara loam, 9 to 14 percent slopes
GaE	Gara loam, 14 to 20 percent slopes
GbD3	Gara clay loam, 9 to 14 percent slopes, severely eroded
GeF	Gasconade flaggy silty clay loam, 14 to 30 percent slopes
GsB	Grundy silt loam, 2 to 5 percent slopes
GuB2	Grundy silty clay loam, 2 to 5 percent slopes, eroded
Ha	Haig silt loam
Hu	Humeston silt loam
LaC	Ladoga silt loam, 5 to 9 percent slopes
LgB	Lagonda silt loam, 2 to 5 percent slopes
LgC2	Lagonda silt loam, 5 to 9 percent slopes, eroded
LhC3	Lagonda silty clay loam, 5 to 9 percent slopes, severely eroded
LmC2	Lamoni clay loam, 5 to 9 percent slopes, eroded
LmC3	Lamoni clay loam, 5 to 9 percent slopes, severely eroded
No	Nodaway silt loam
PeB	Pershing silt loam, 2 to 5 percent slopes
PeC	Pershing silt loam, 5 to 9 percent slopes
PgC3	Pershing silty clay loam, 5 to 9 percent slopes, severely eroded
Pt	Pits, quarries
ShD	Shelby loam, 9 to 14 percent slopes
ShE	Shelby loam, 14 to 20 percent slopes
SkD3	Shelby clay loam, 9 to 14 percent slopes, severely eroded
SkE3	Shelby clay loam, 14 to 20 percent slopes, severely eroded
Wa	Wabash silty clay
WeB	Weller silt loam, 2 to 5 percent slopes
WeC	Weller silt loam, 5 to 9 percent slopes
WgC3	Weller silty clay loam, 5 to 9 percent slopes, severely eroded
Zo	Zook silty clay loam
Zz	Zook-Colo silty clay loams, channeled

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CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; w)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; w)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CeA; FoB2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

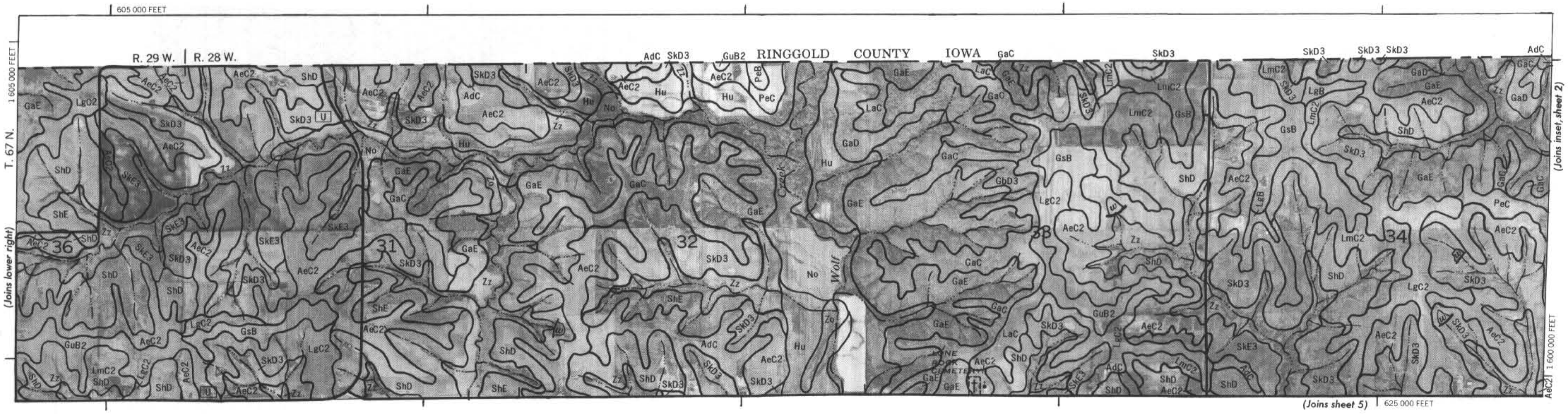
SOIL SAMPLE SITE (normally not shown)

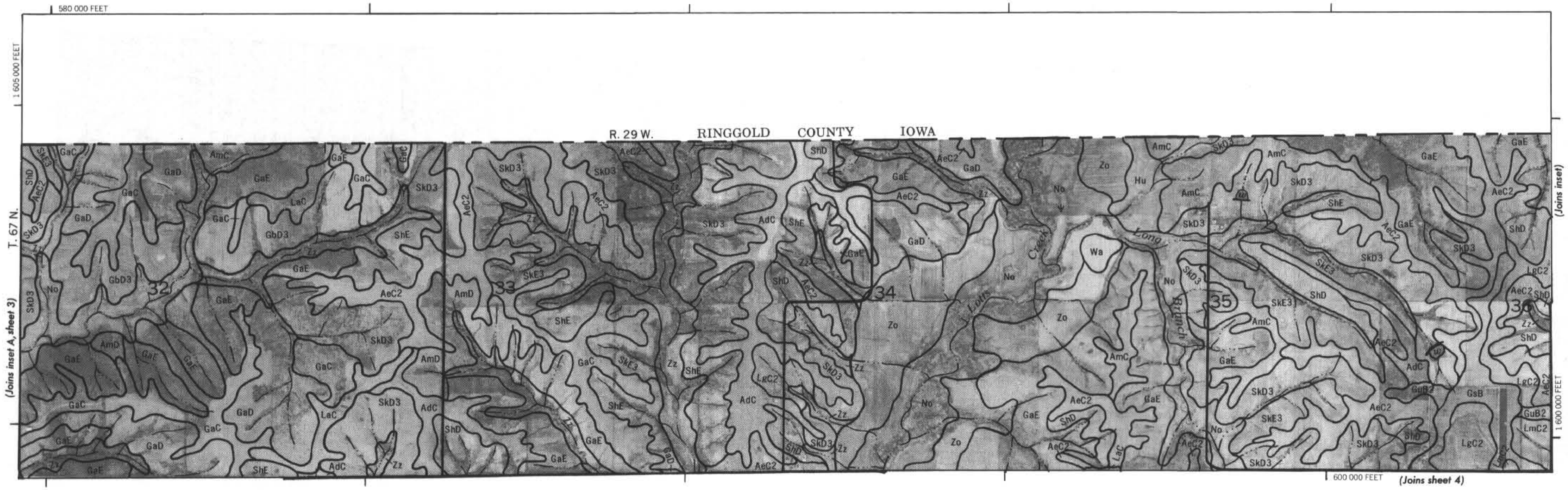
MISCELLANEOUS

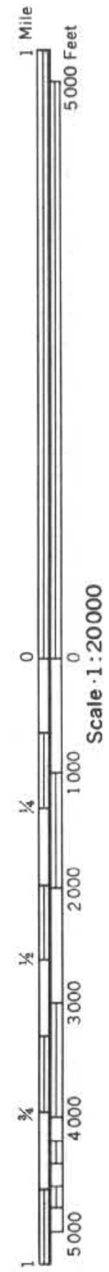
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Airport, small

1

N







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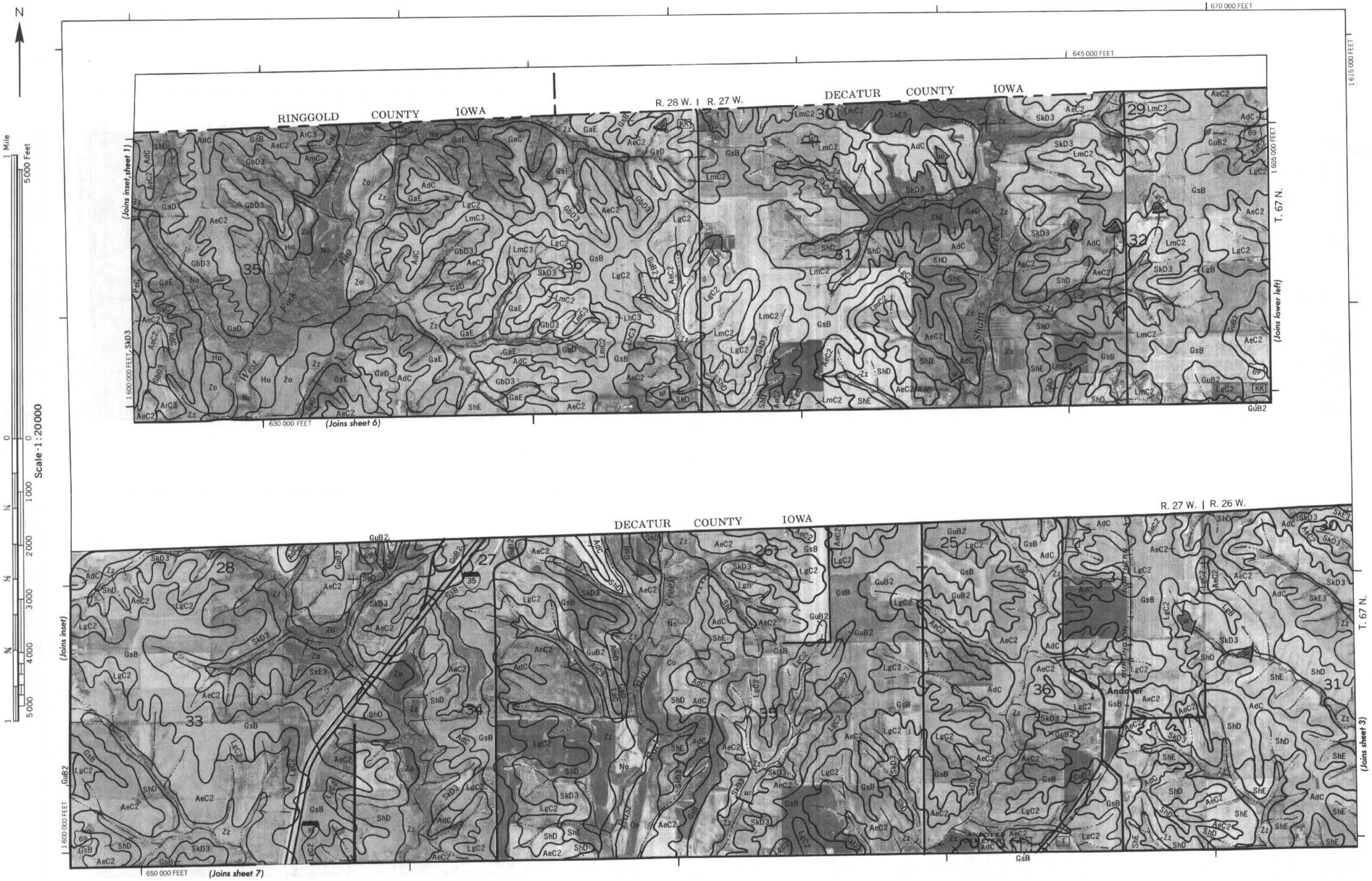

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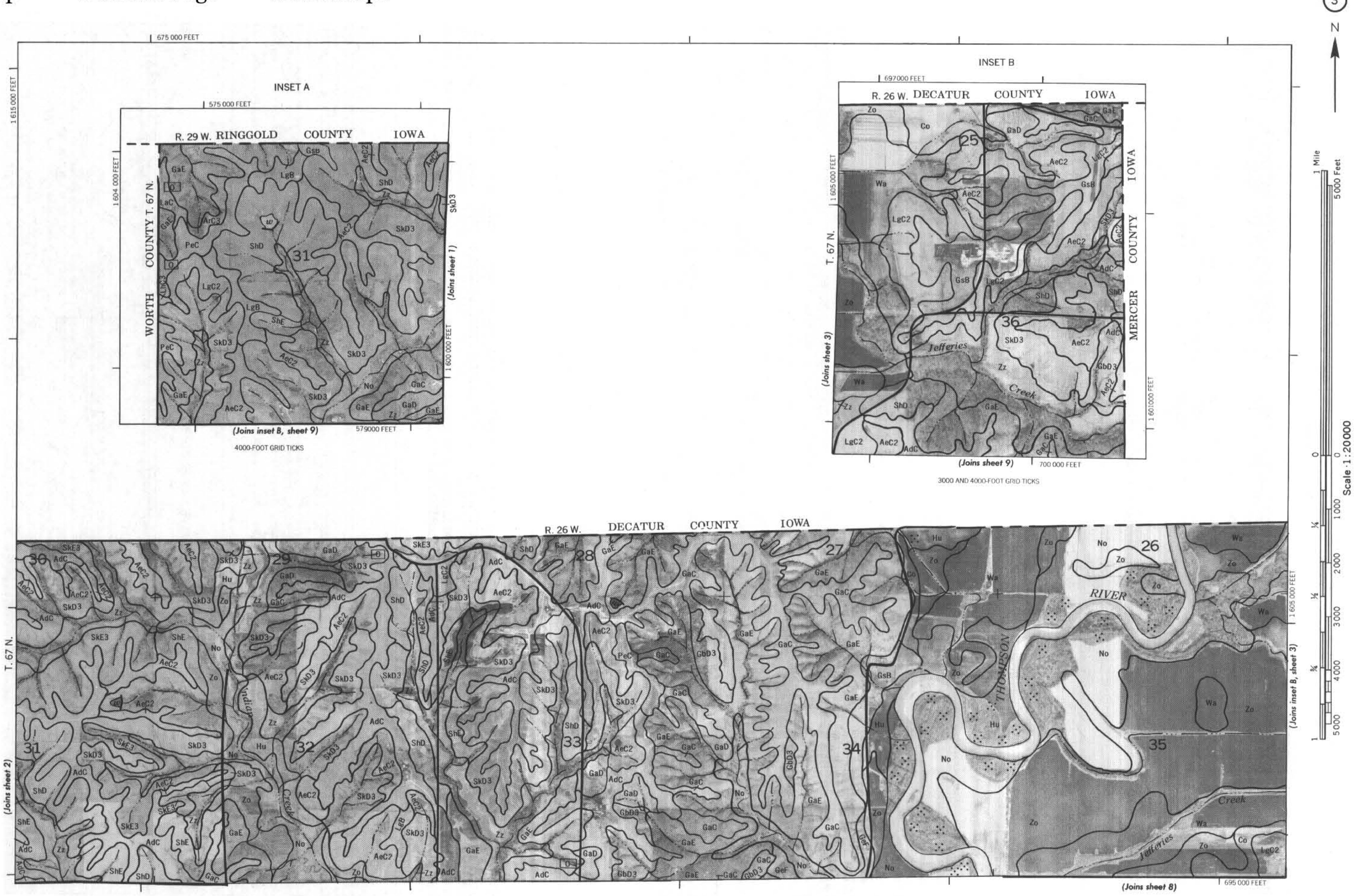

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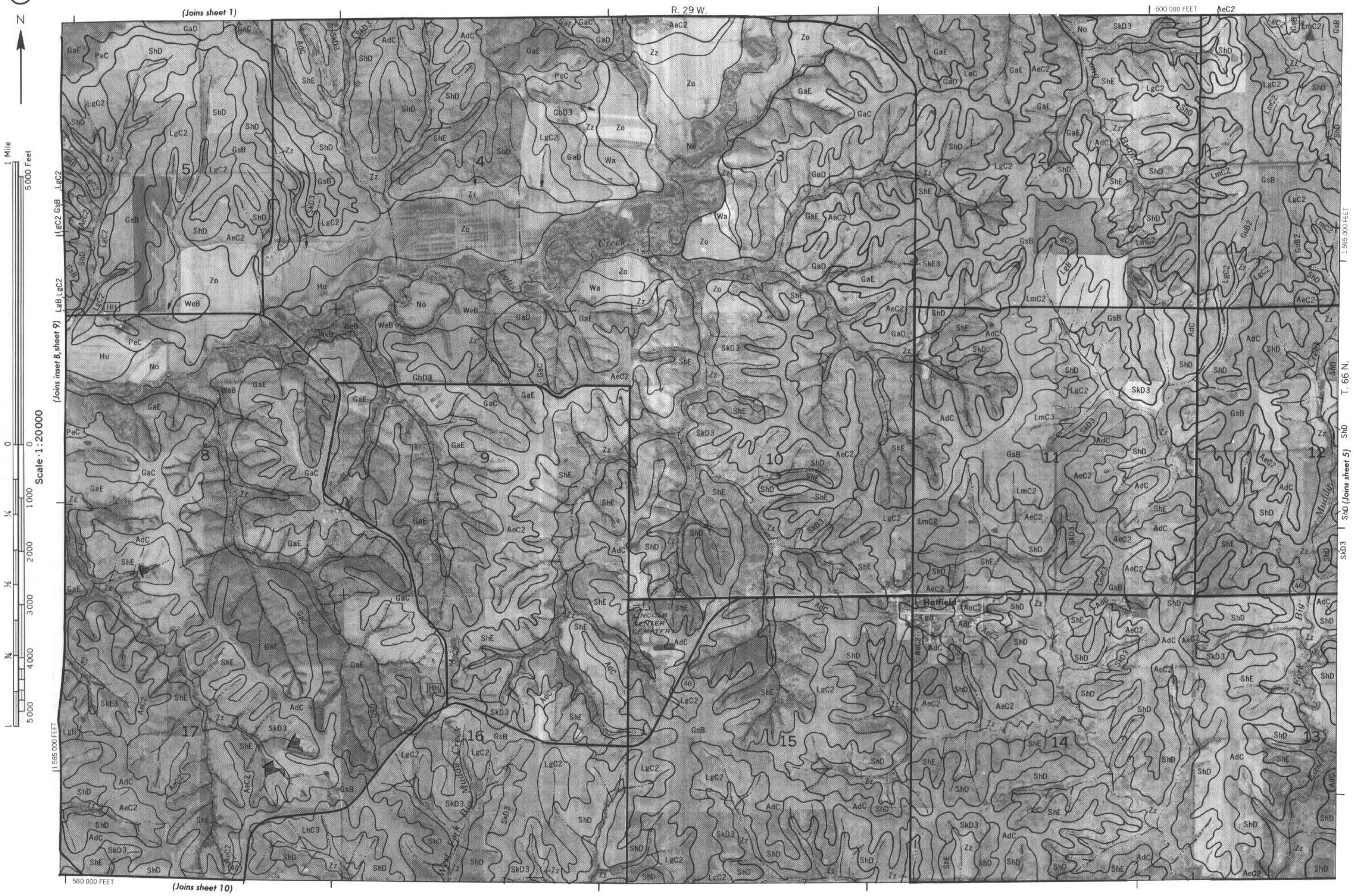

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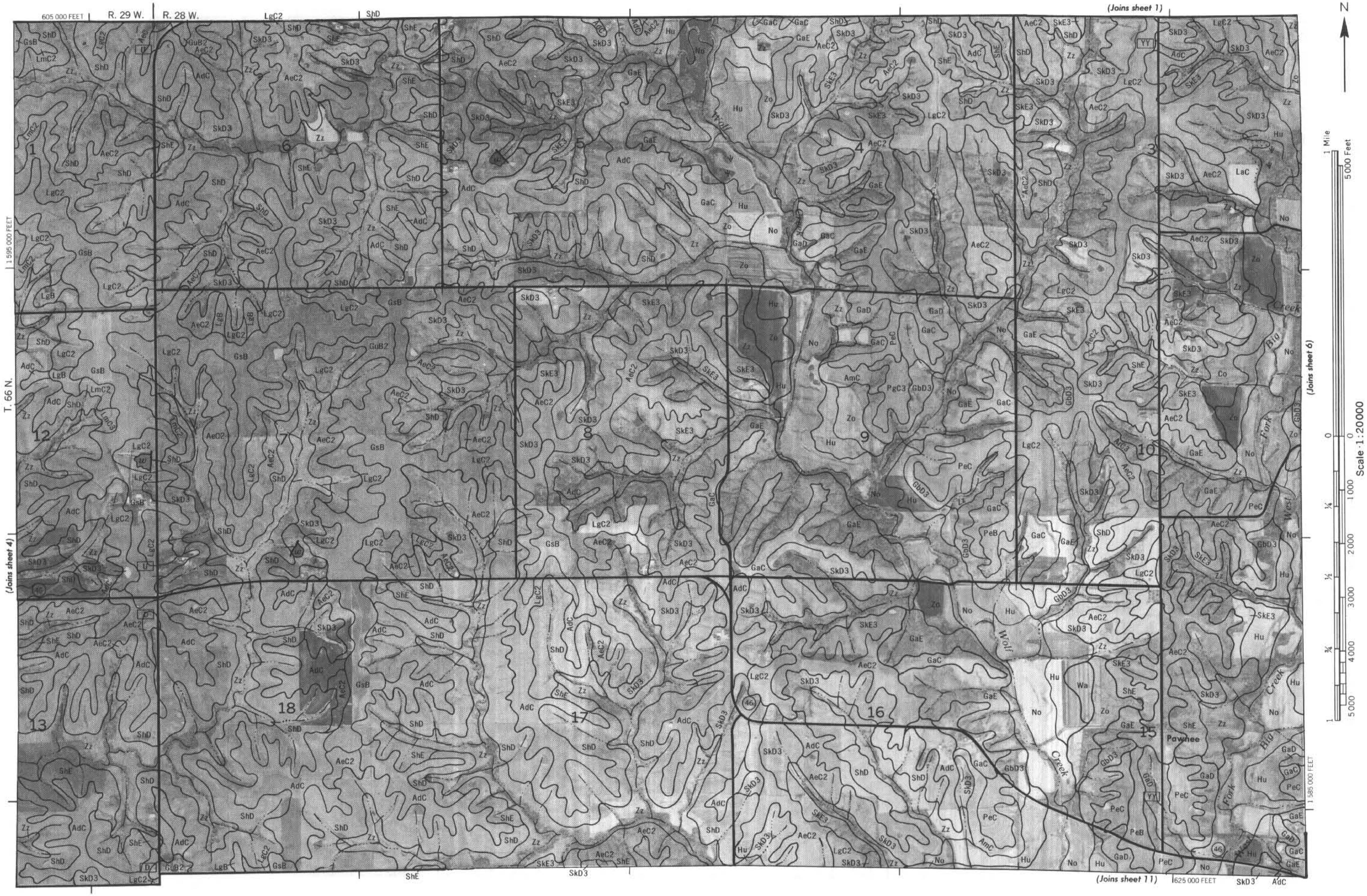

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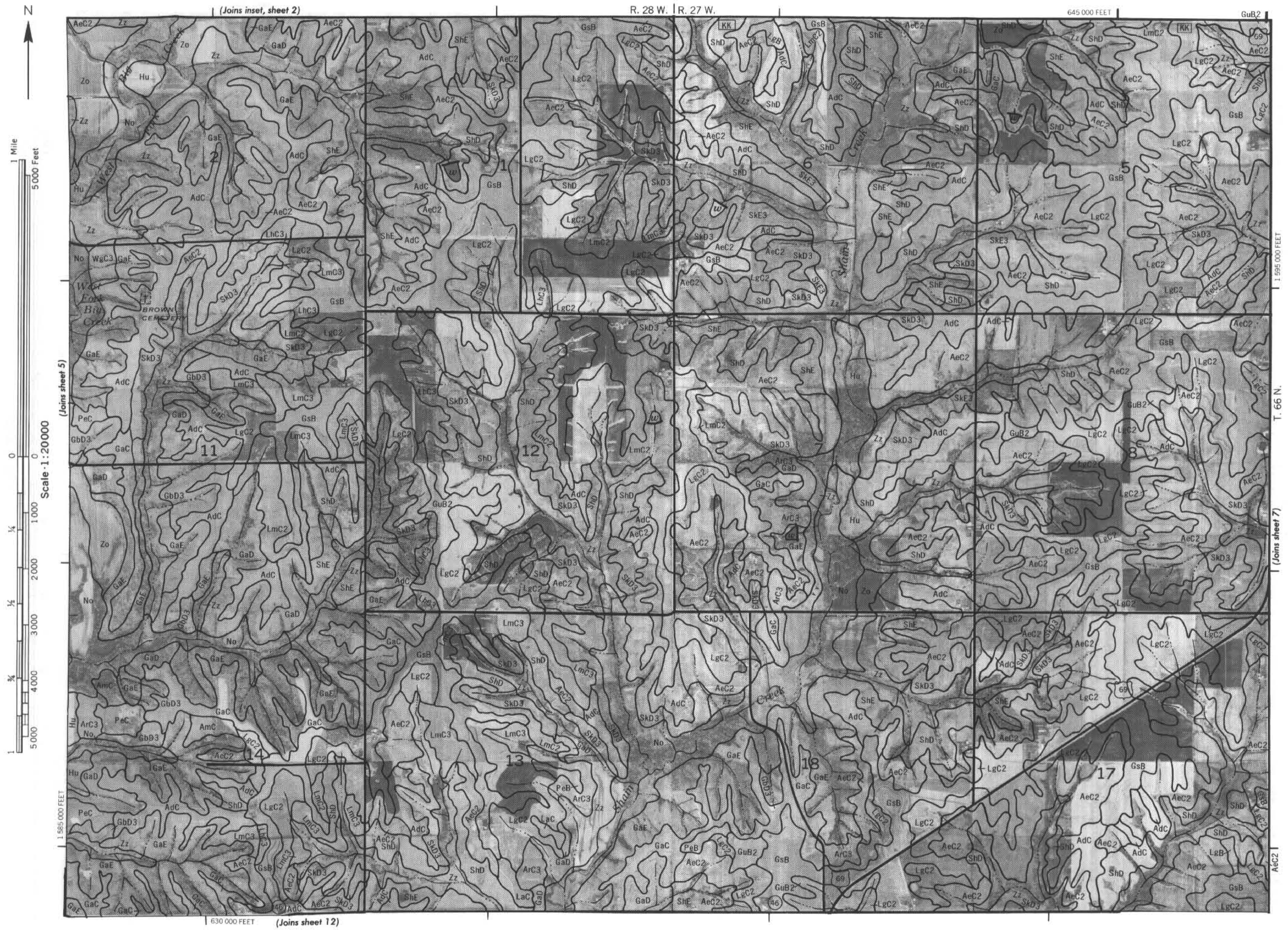

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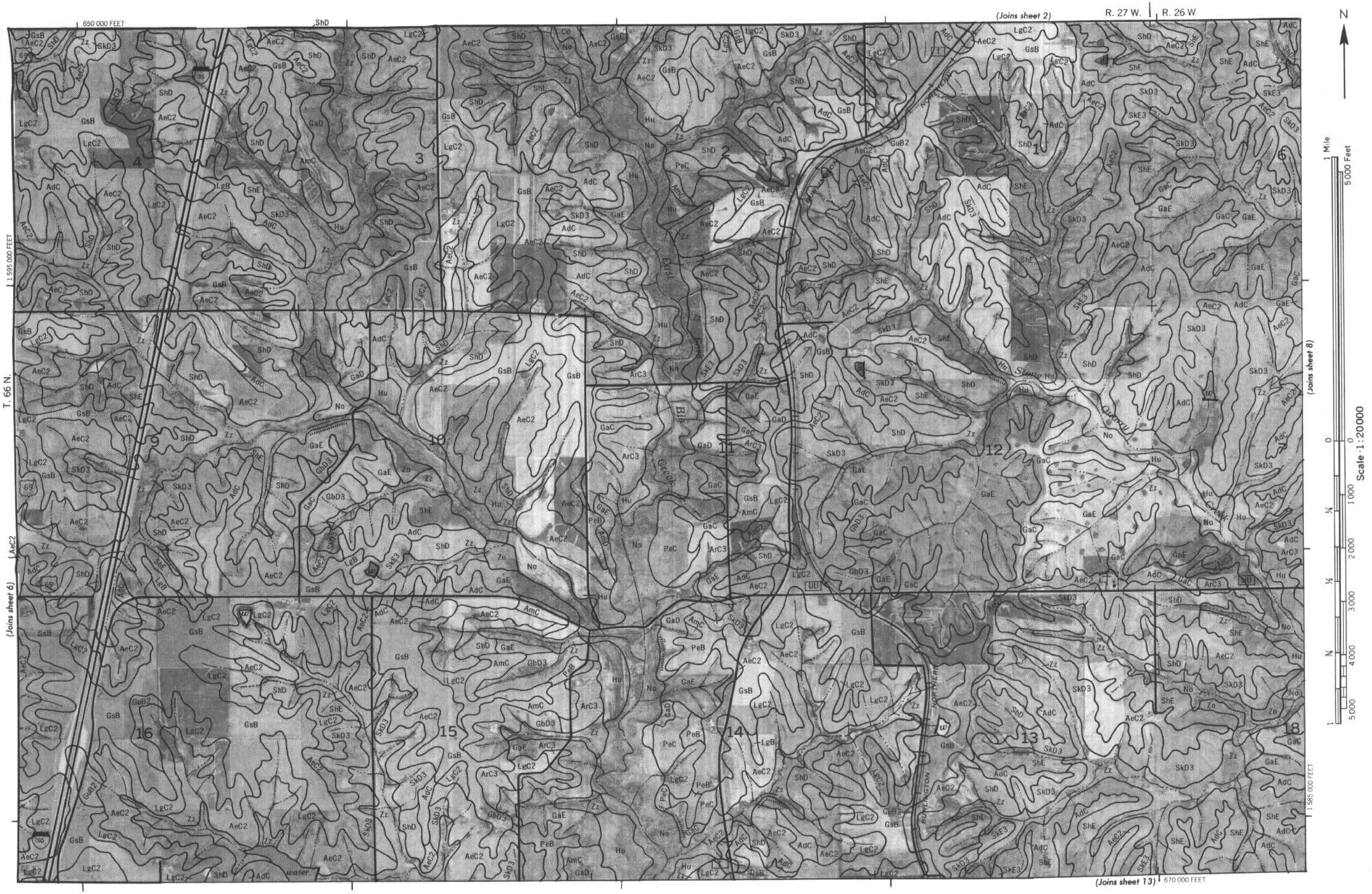

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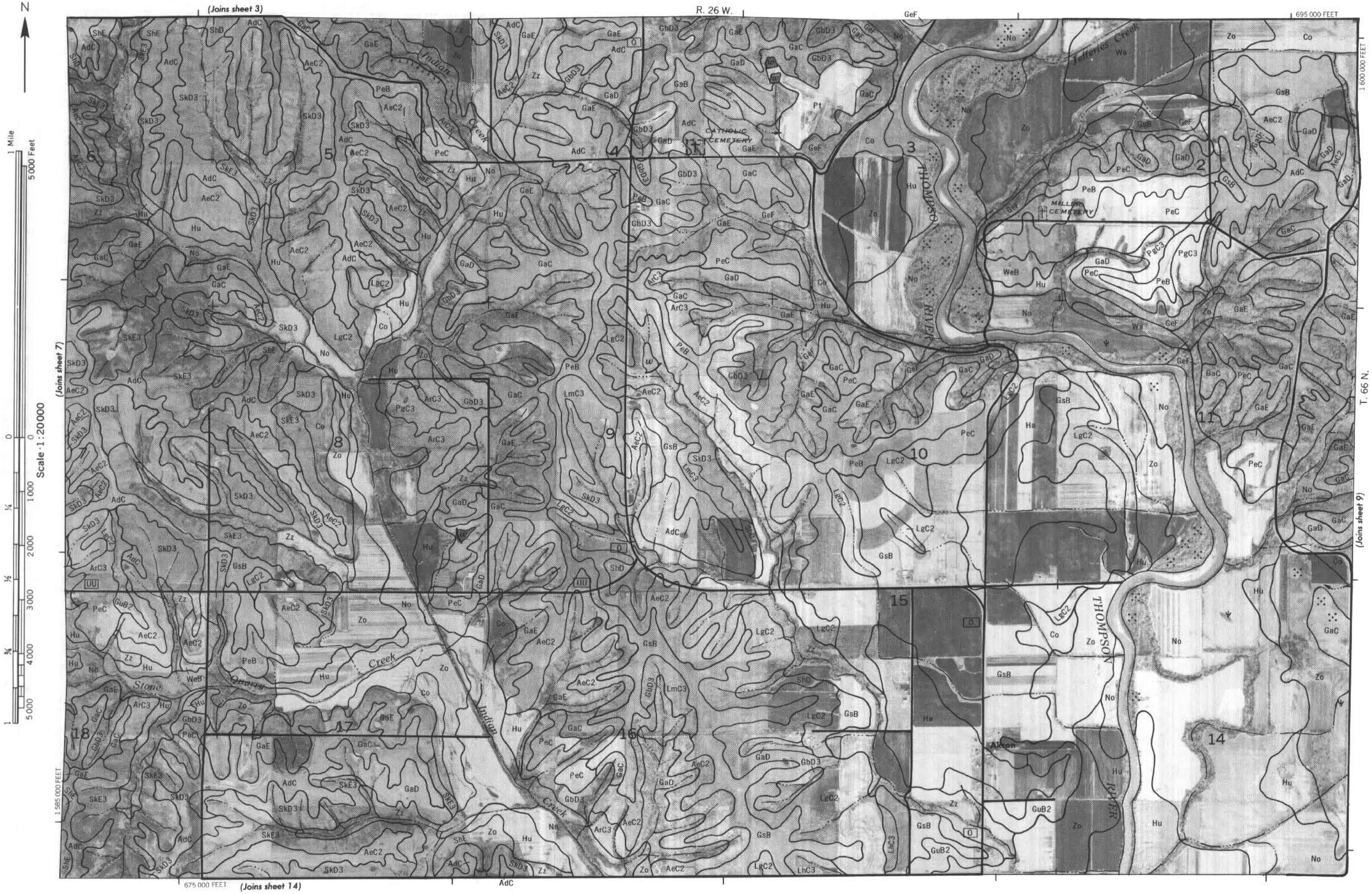

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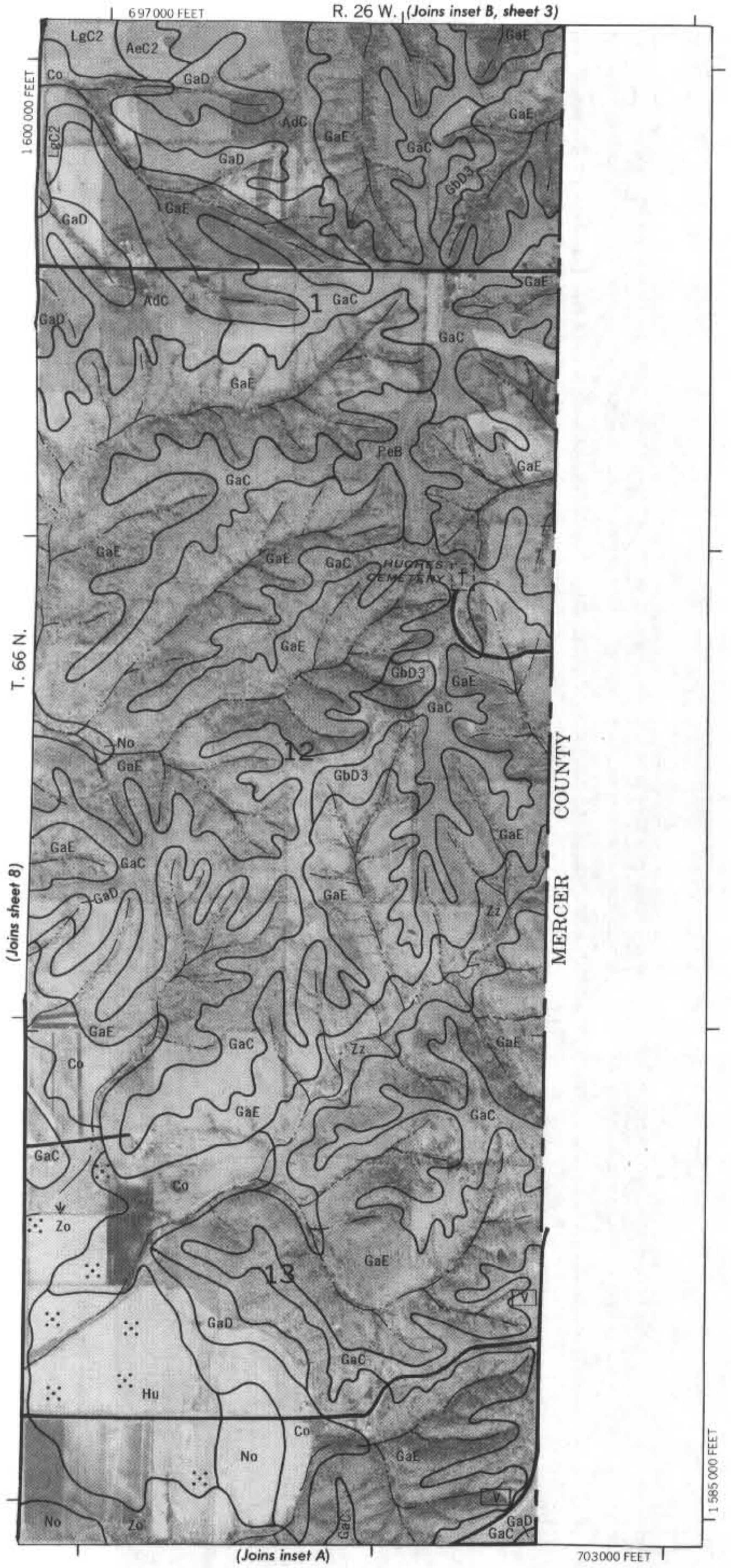
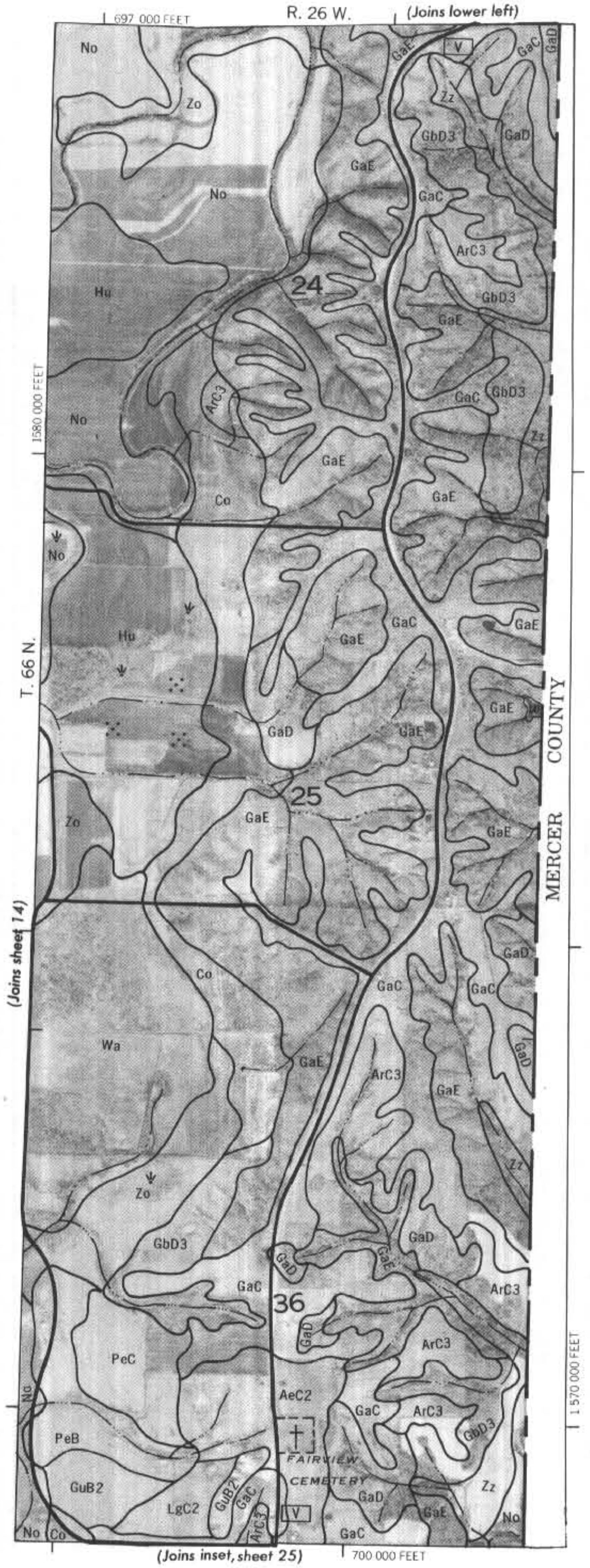


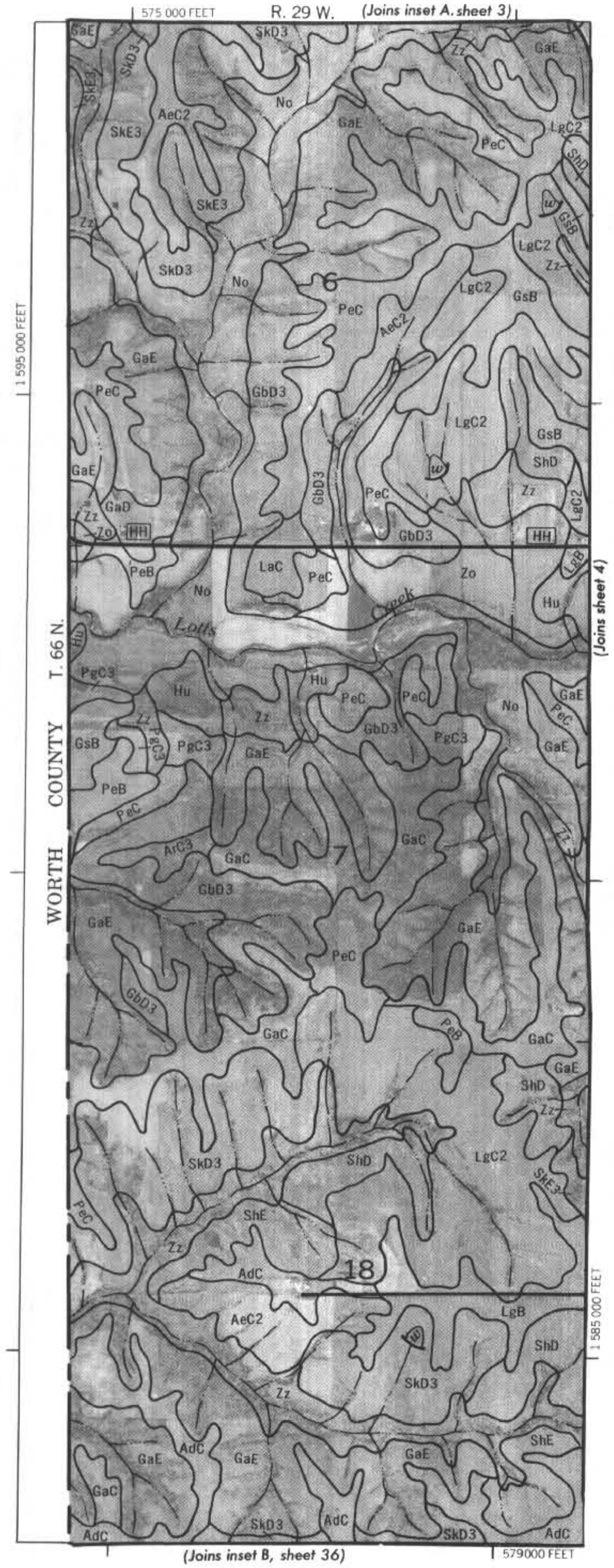
3000 AND 5000-FOOT GRID TICKS

INSET A



3000 AND 5000-FOOT GRID TICKS

INSET B



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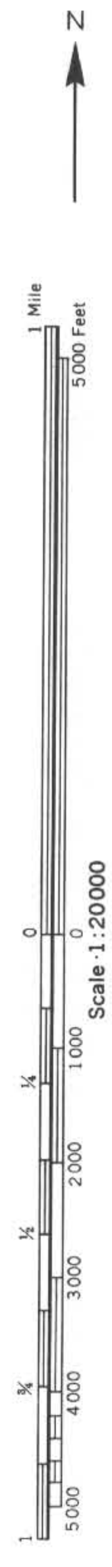

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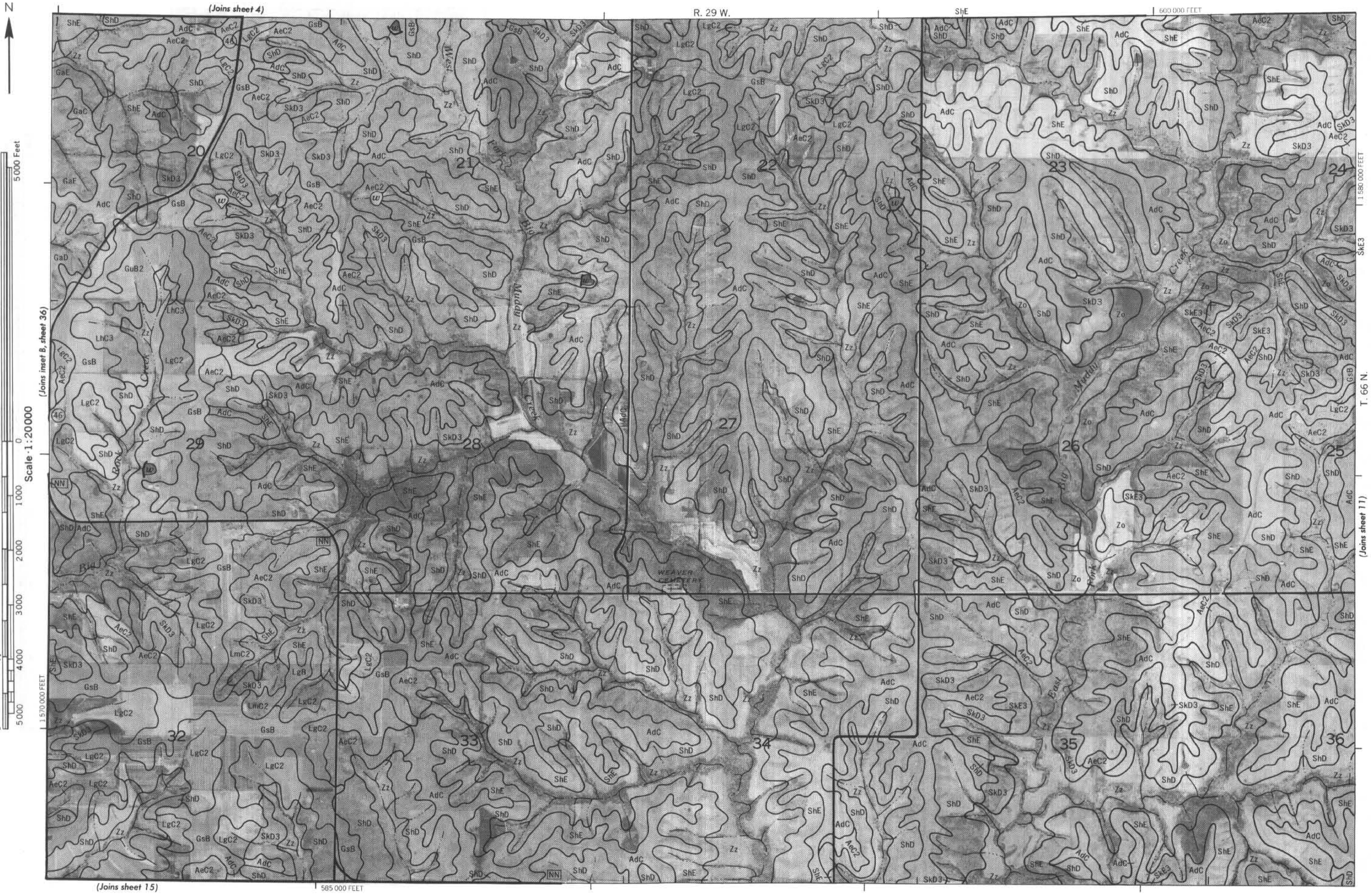

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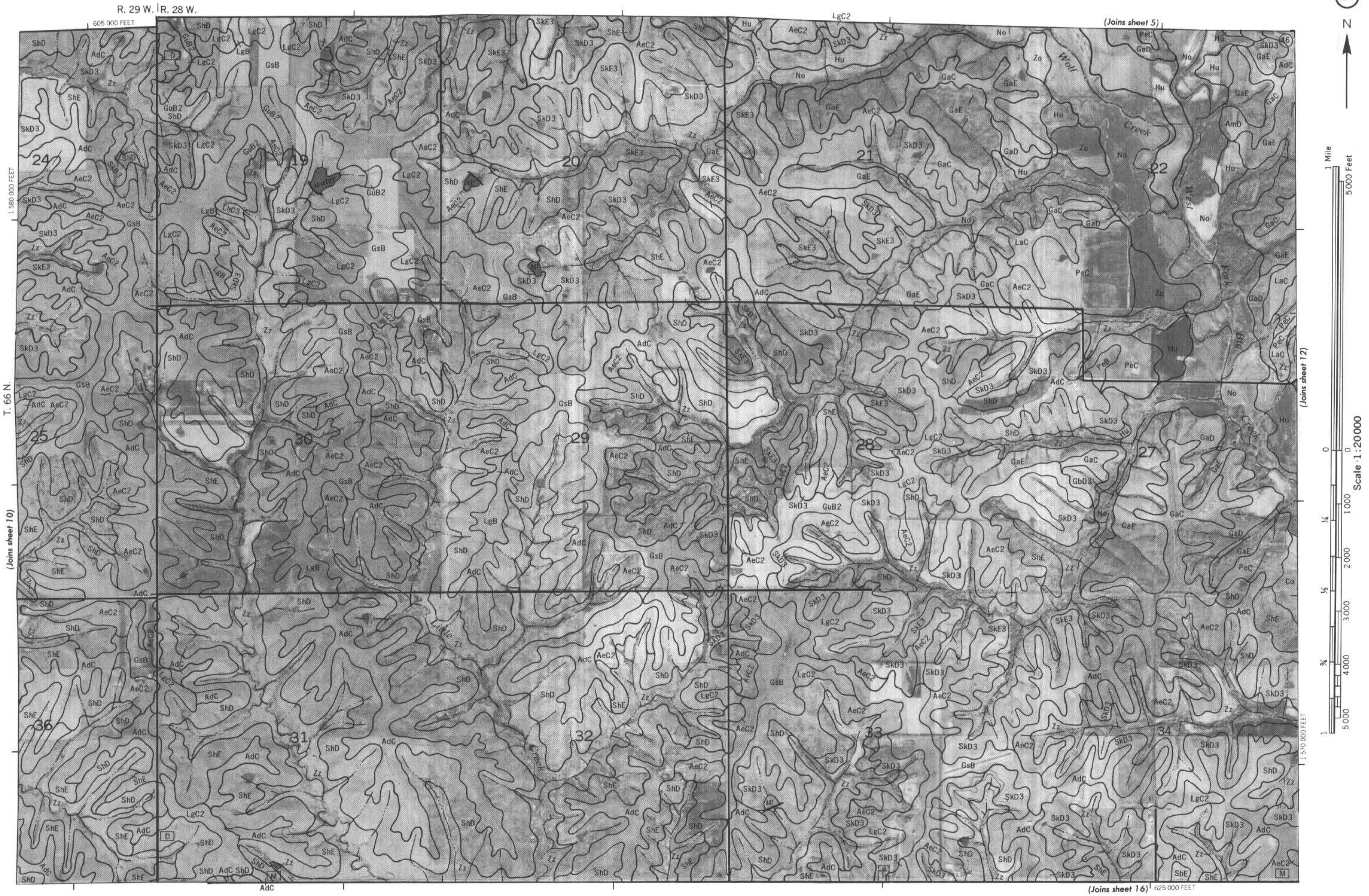

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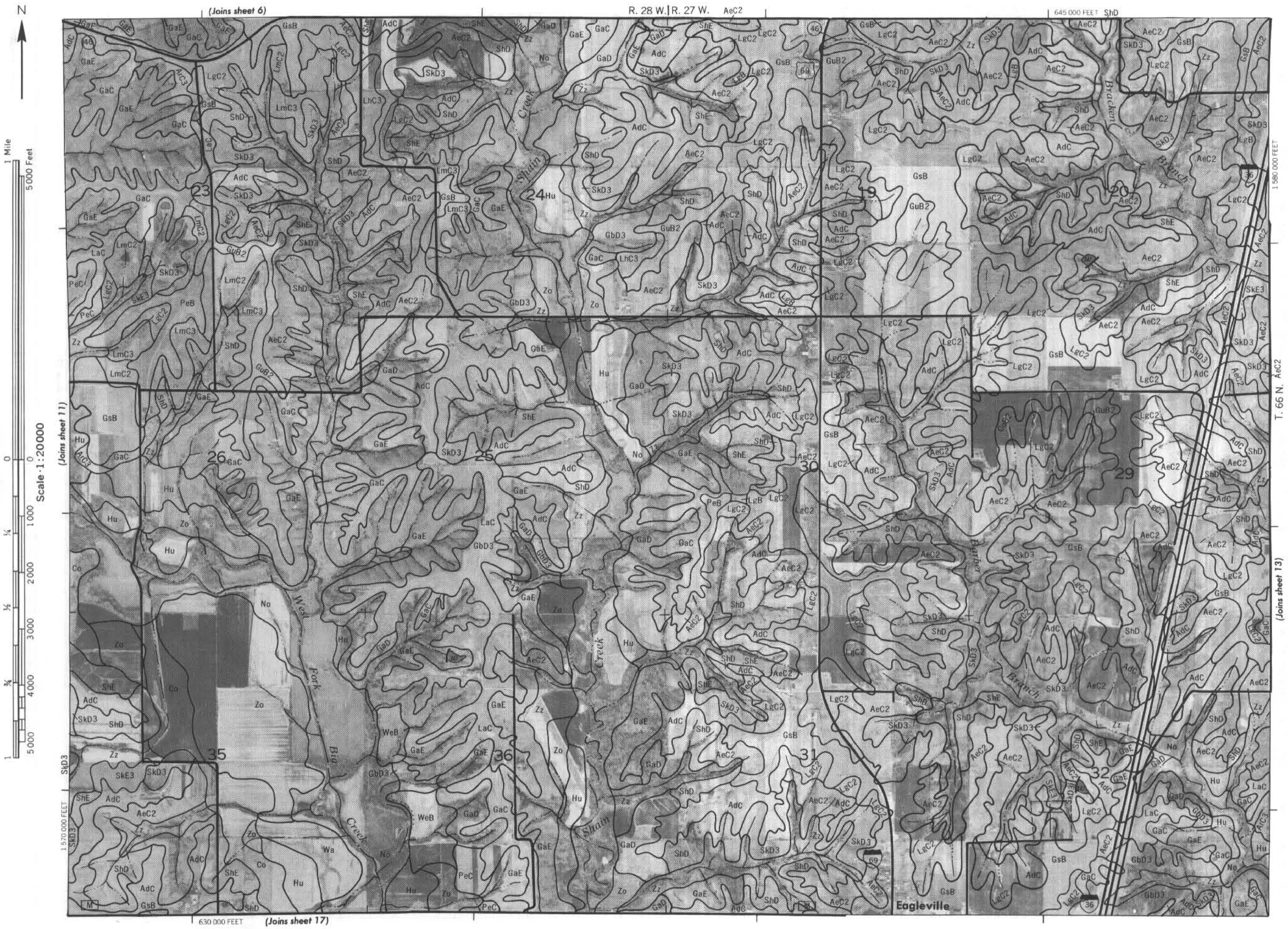

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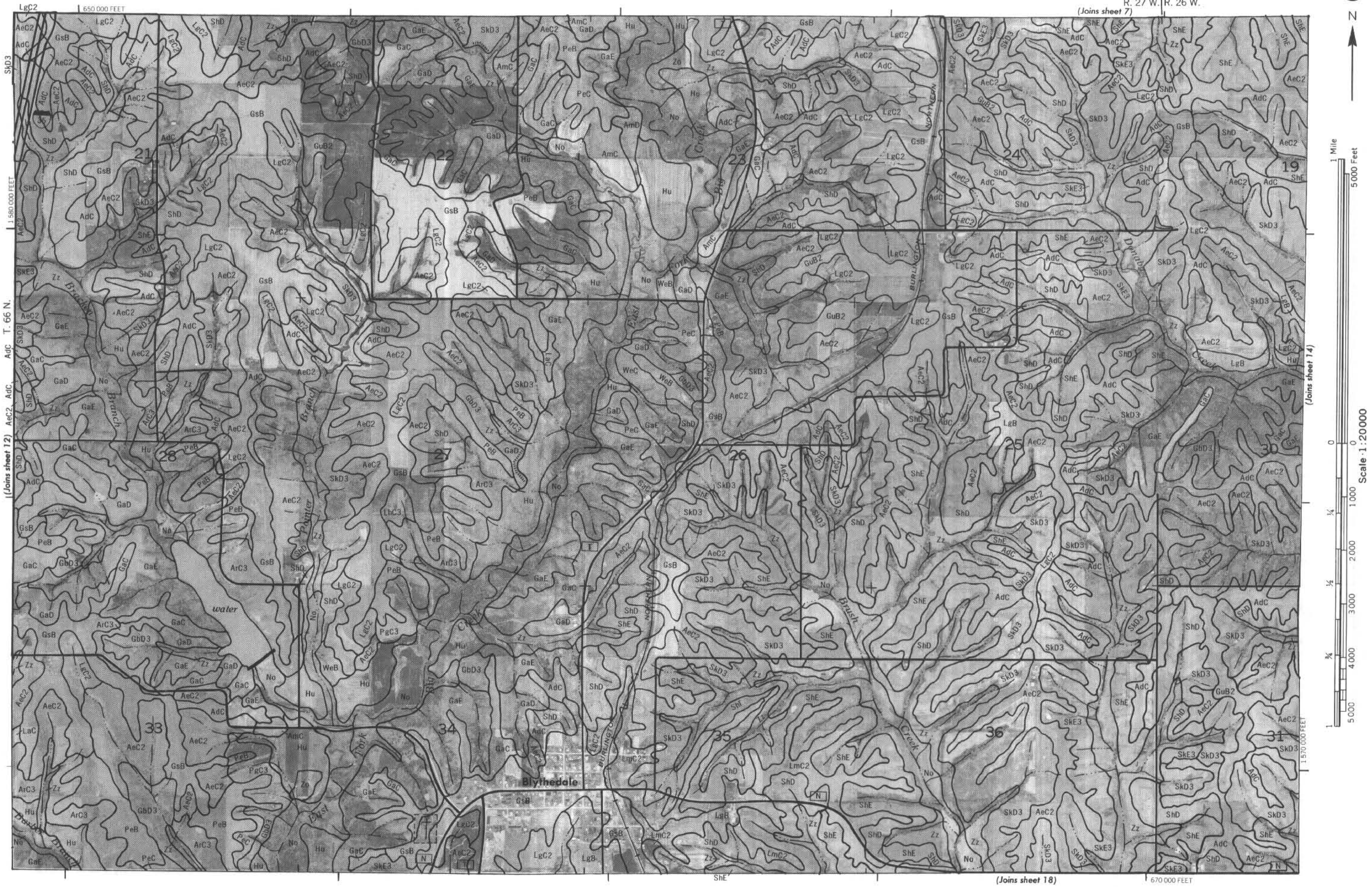

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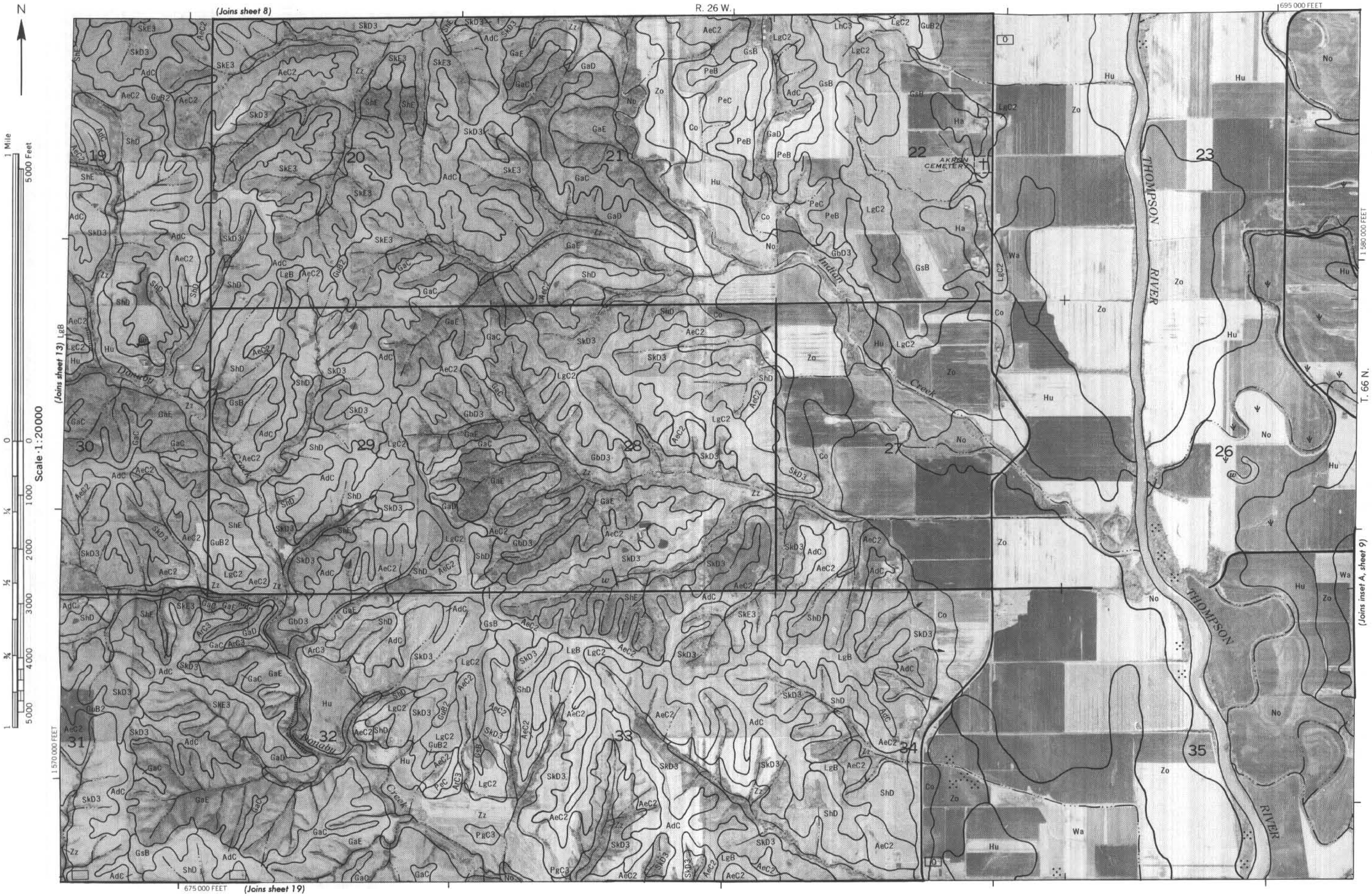

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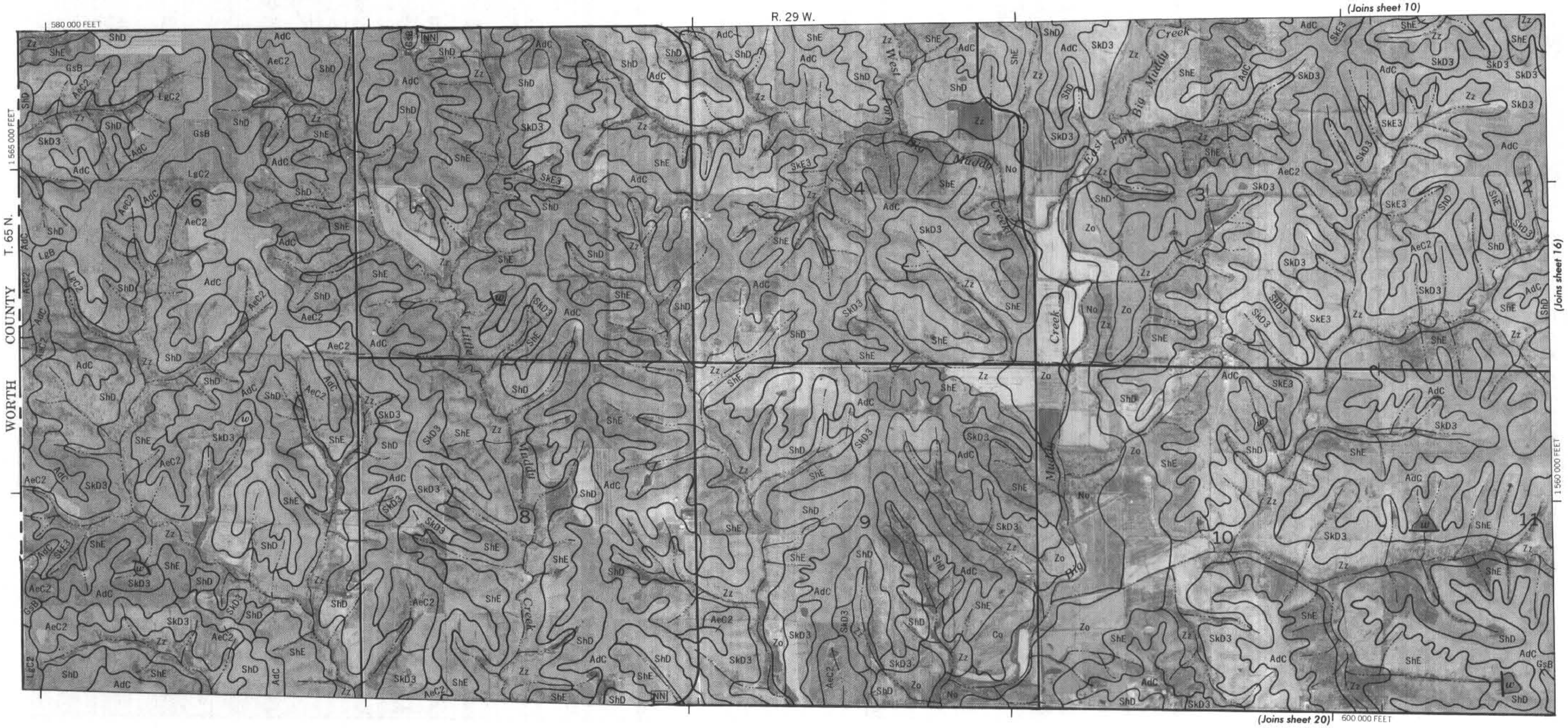

1 Mile
5000 Feet
Scale 1:20000

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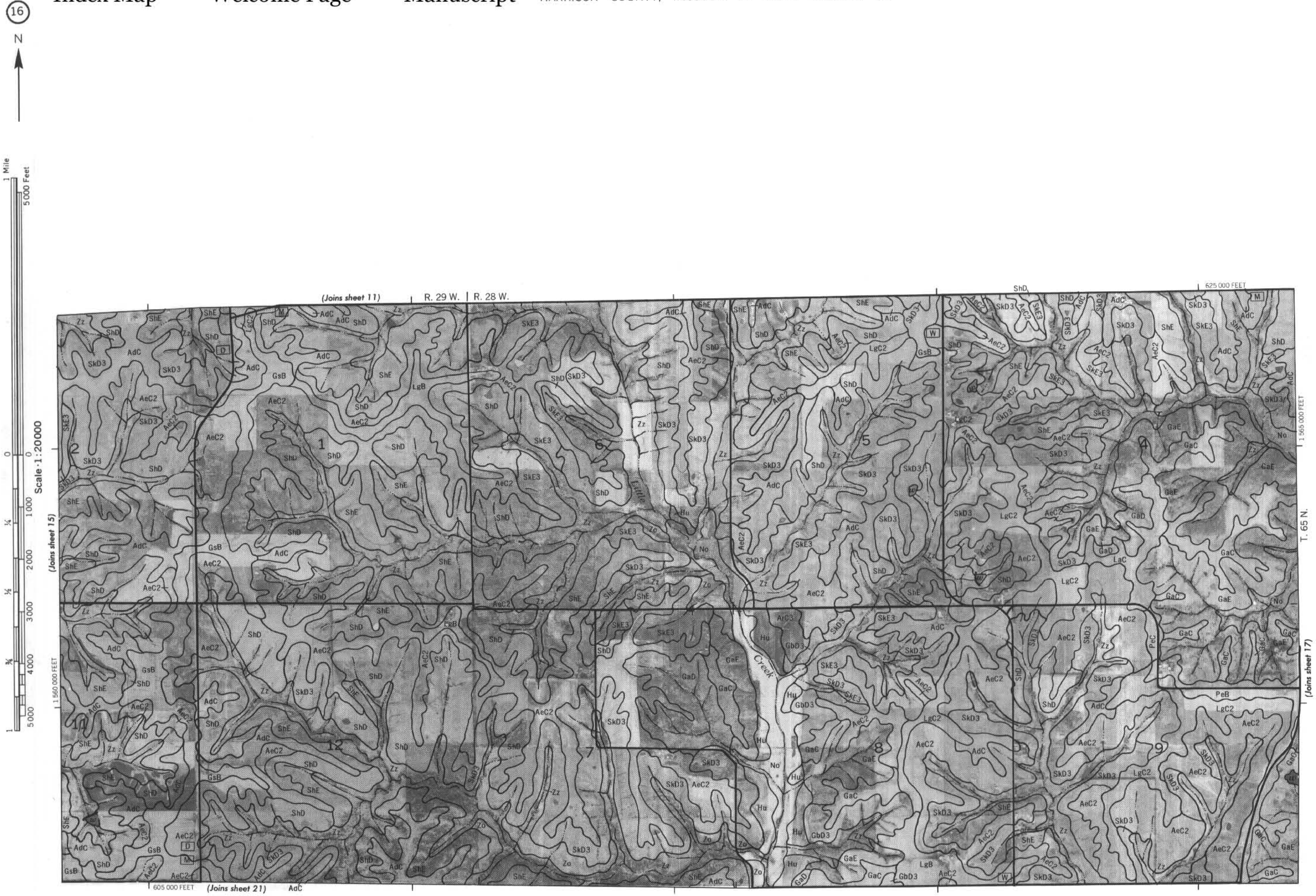

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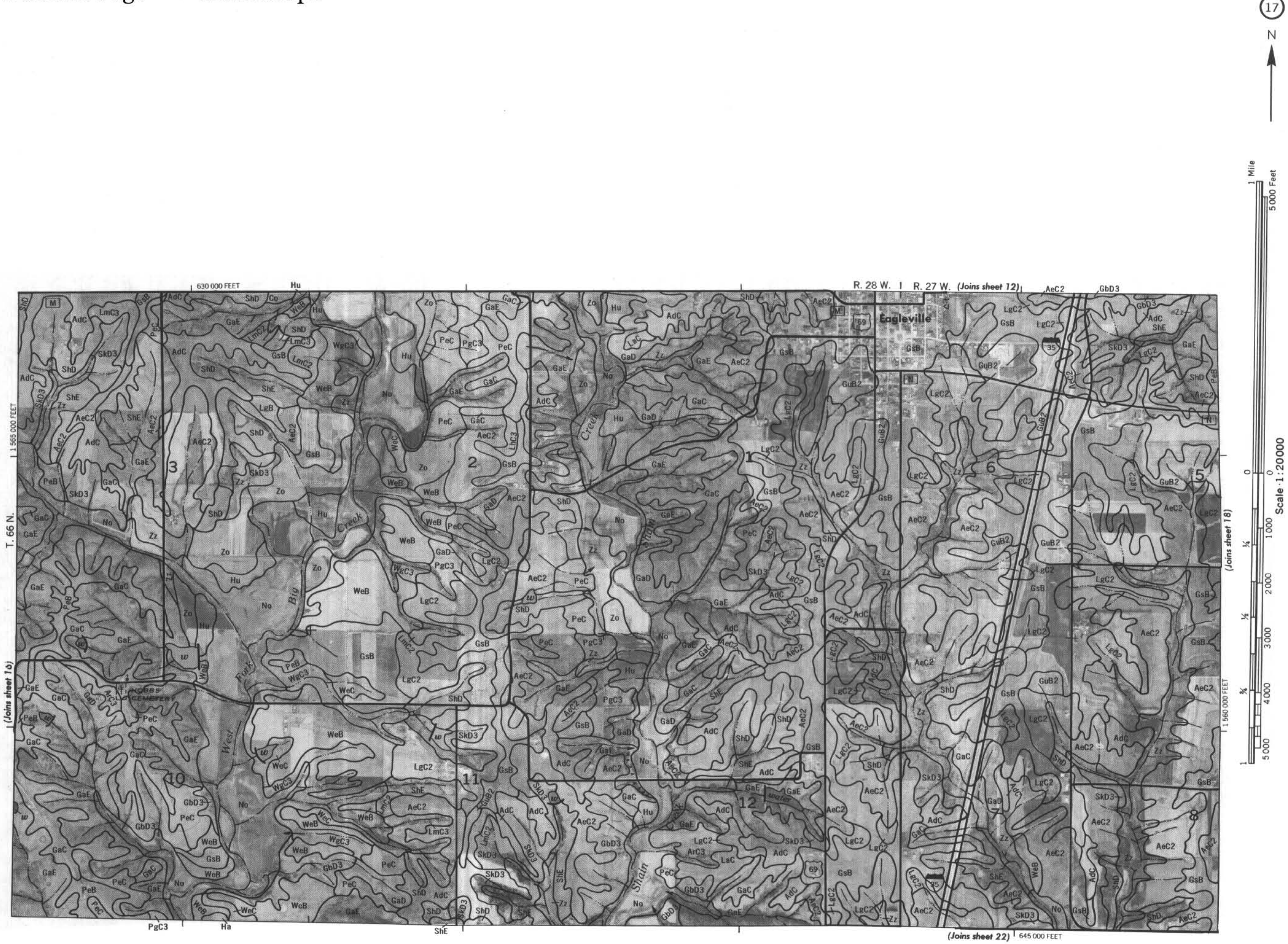

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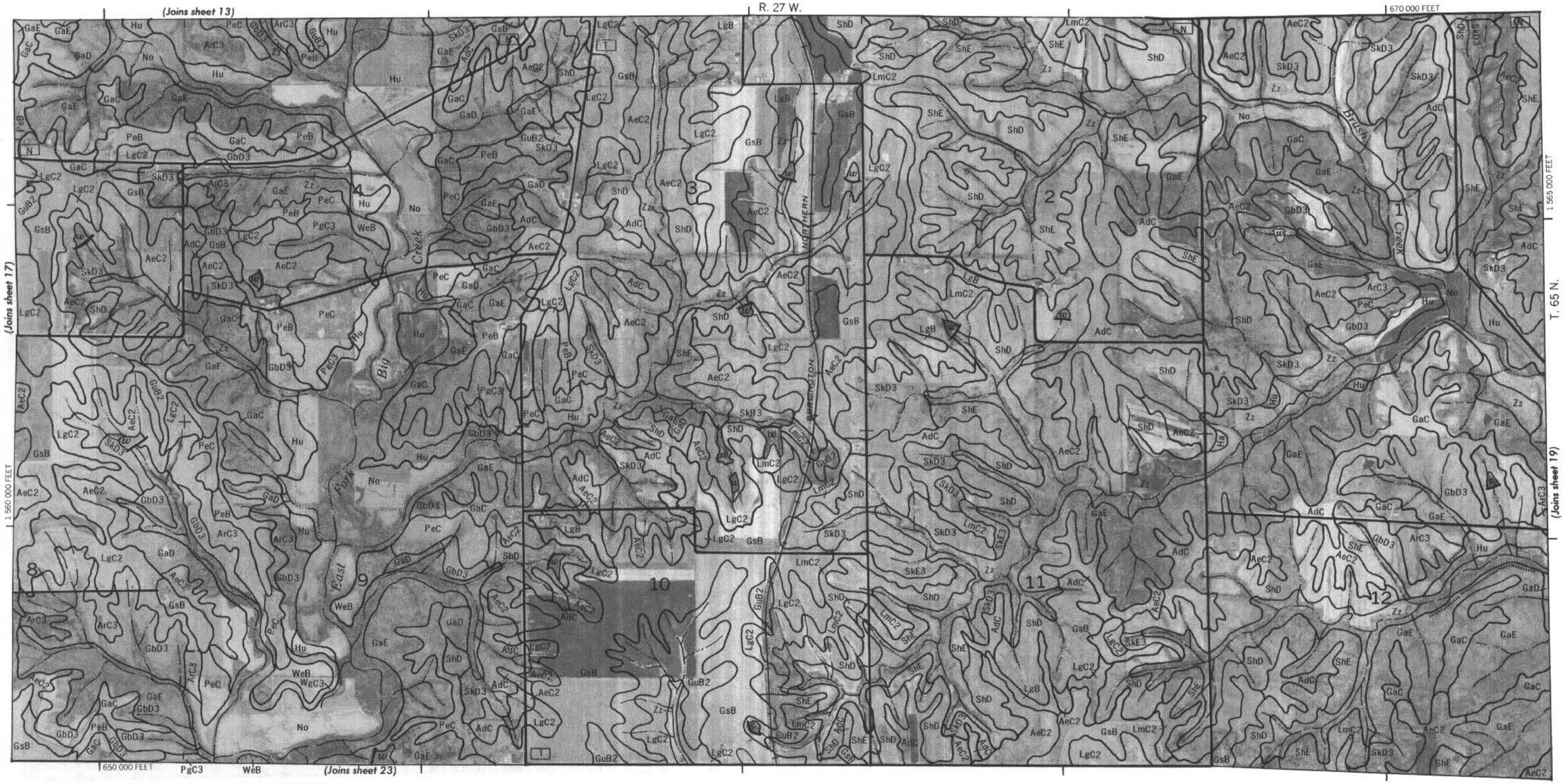
HARRISON COUNTY, MISSOURI — SHEET NUMBER 18

N

1 Mile
5000 Feet
0 1/4 1/2 3/4 1
0 1000 2000 3000 4000 5000
Scale 1:20000



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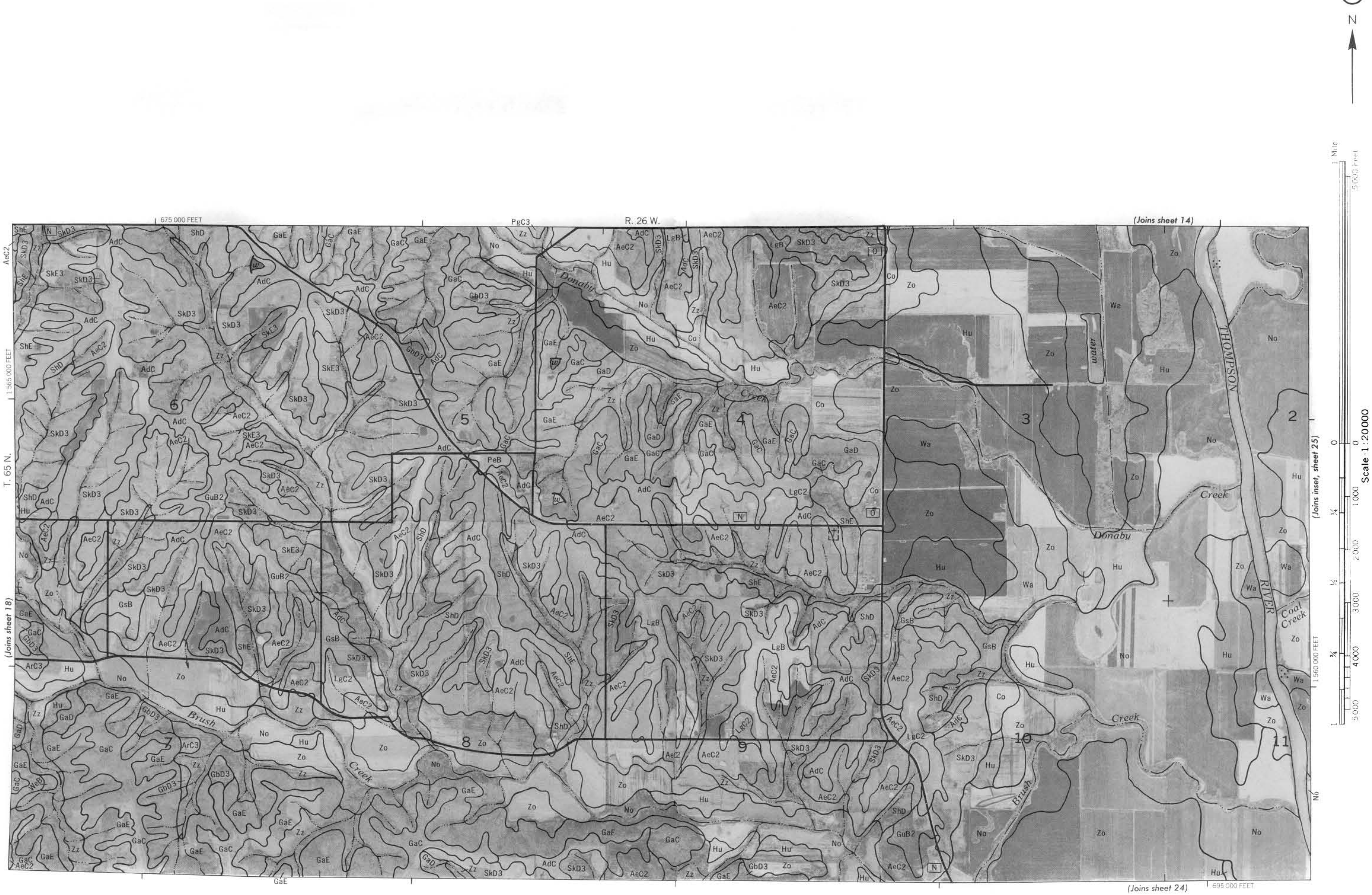
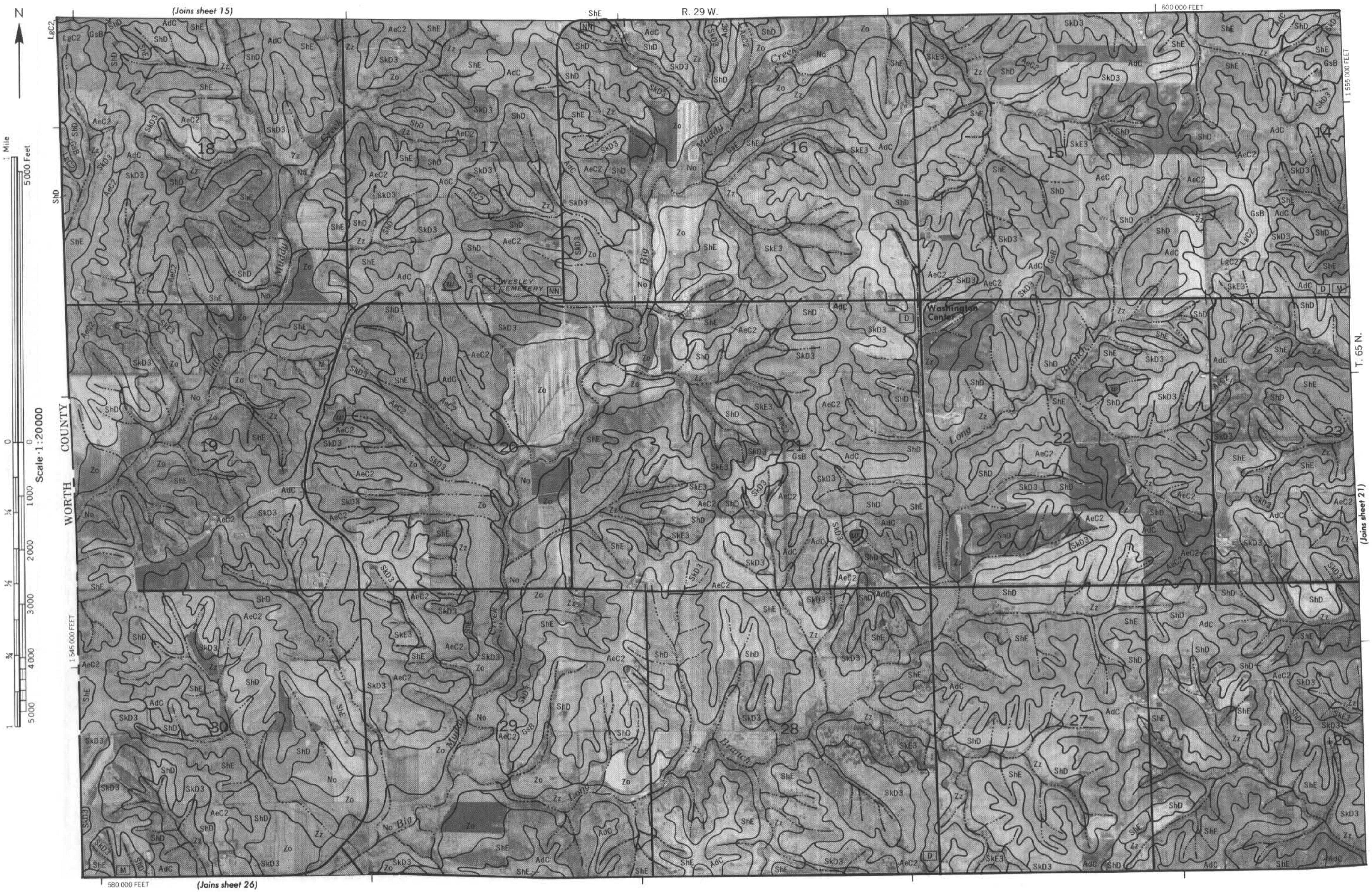
HARRISON COUNTY, MISSOURI — SHEET NUMBER 19





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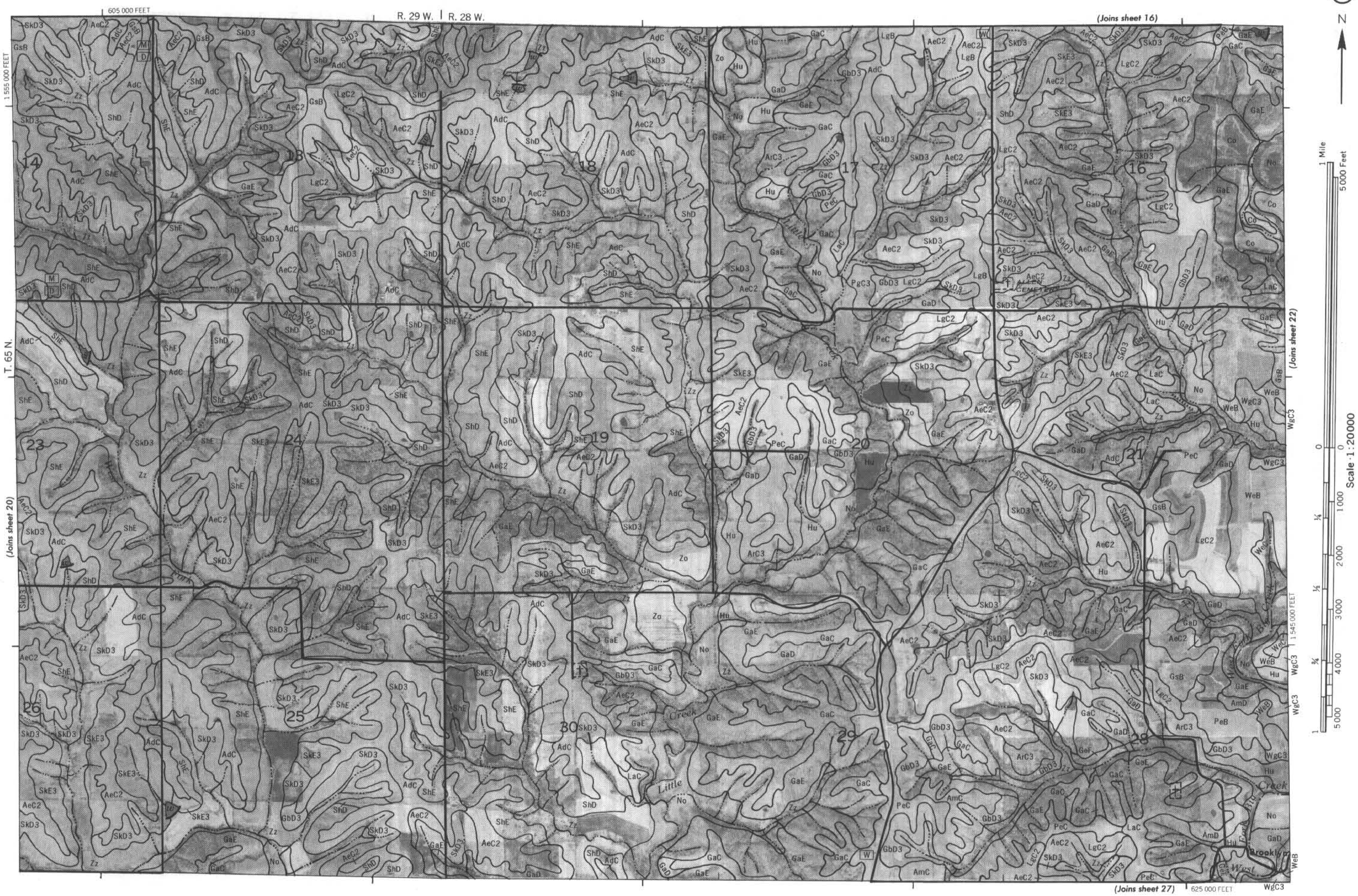
HARRISON COUNTY, MISSOURI NO. 20

HARRISON COUNTY, MISSOURI — SHEET NUMBER 21



HARRISON COUNTY, MISSOURI NO. 21

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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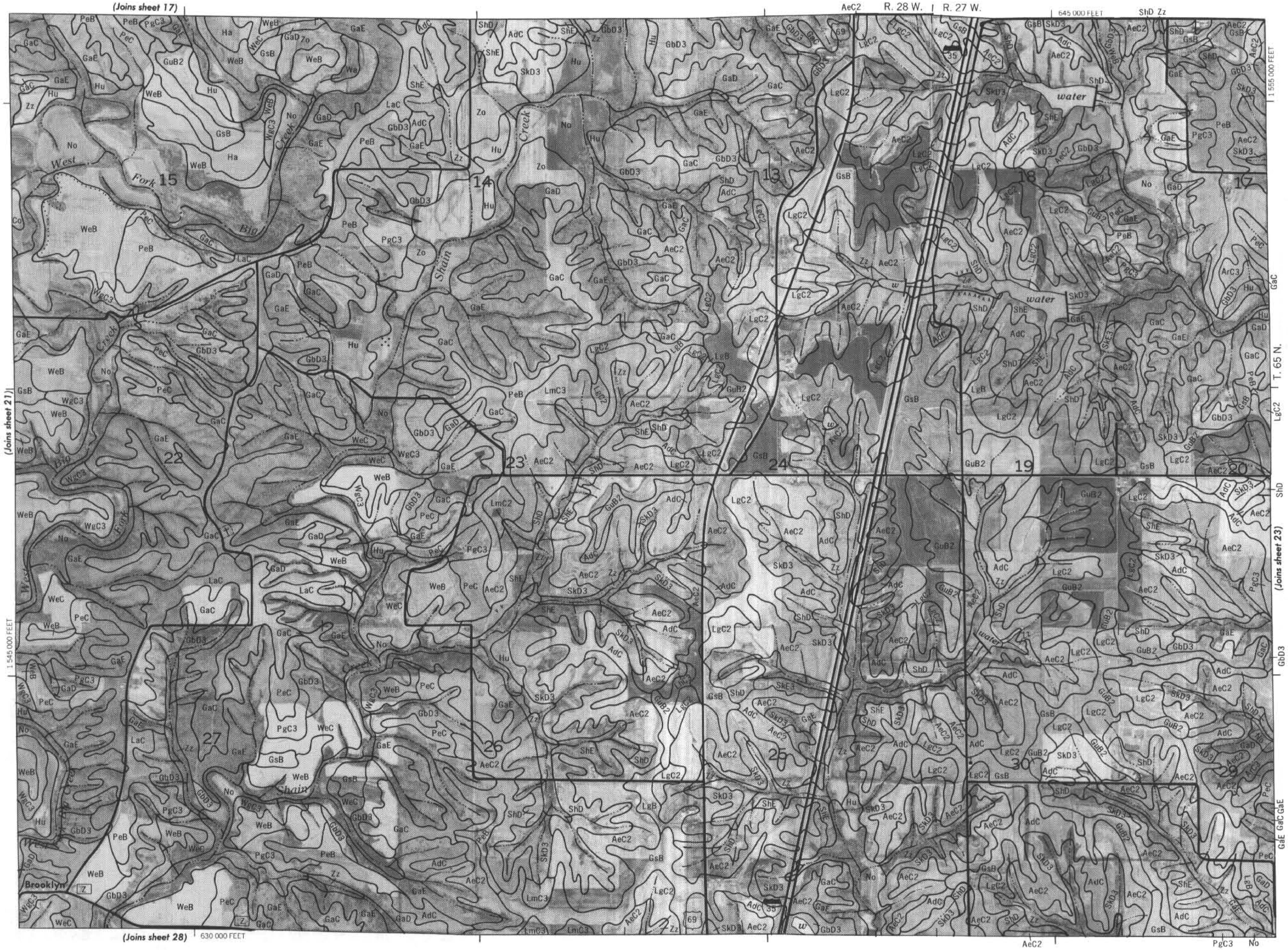
(22)

N

Scale 1:20000

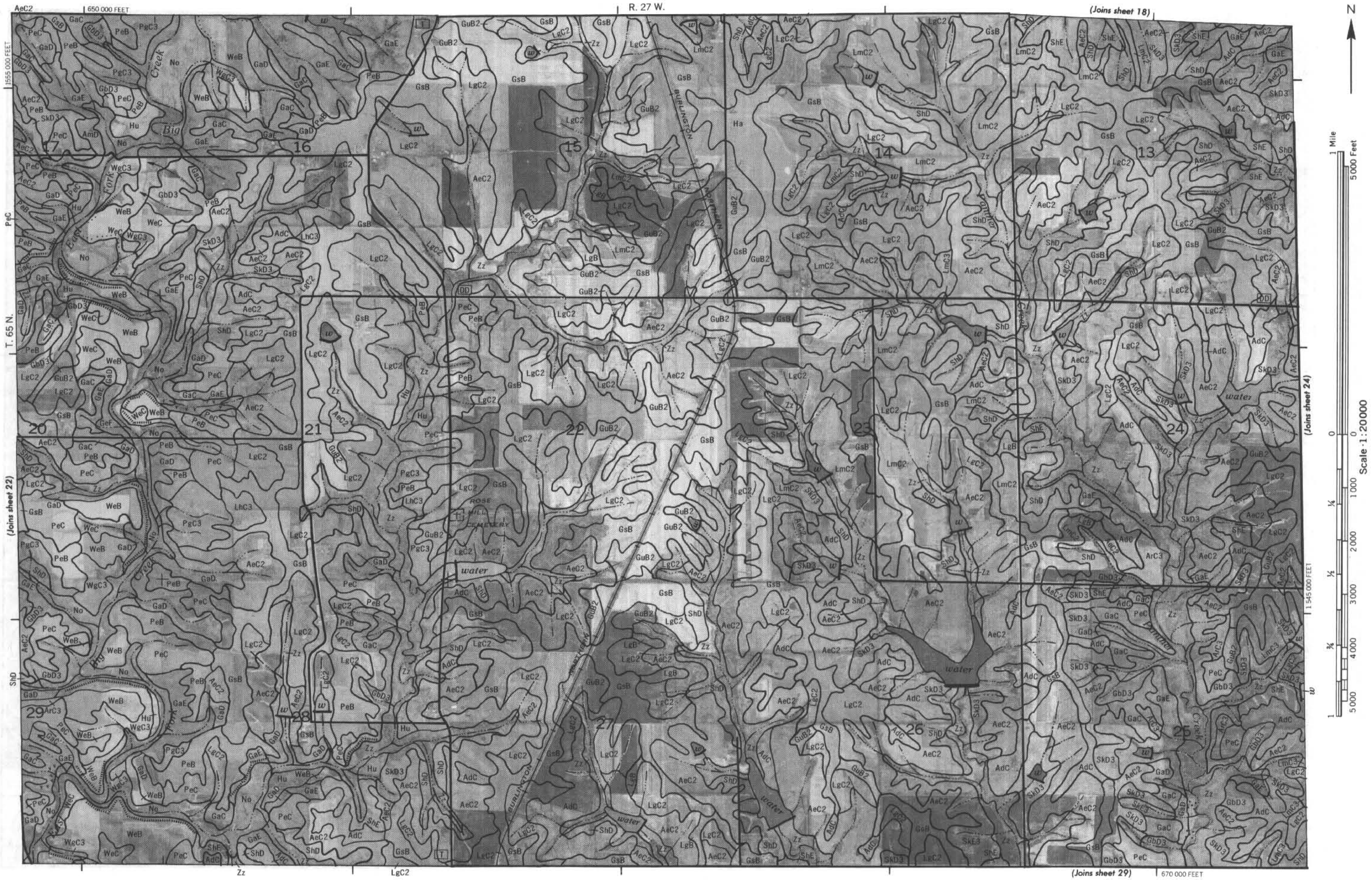
1 Mile 5000 Feet



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

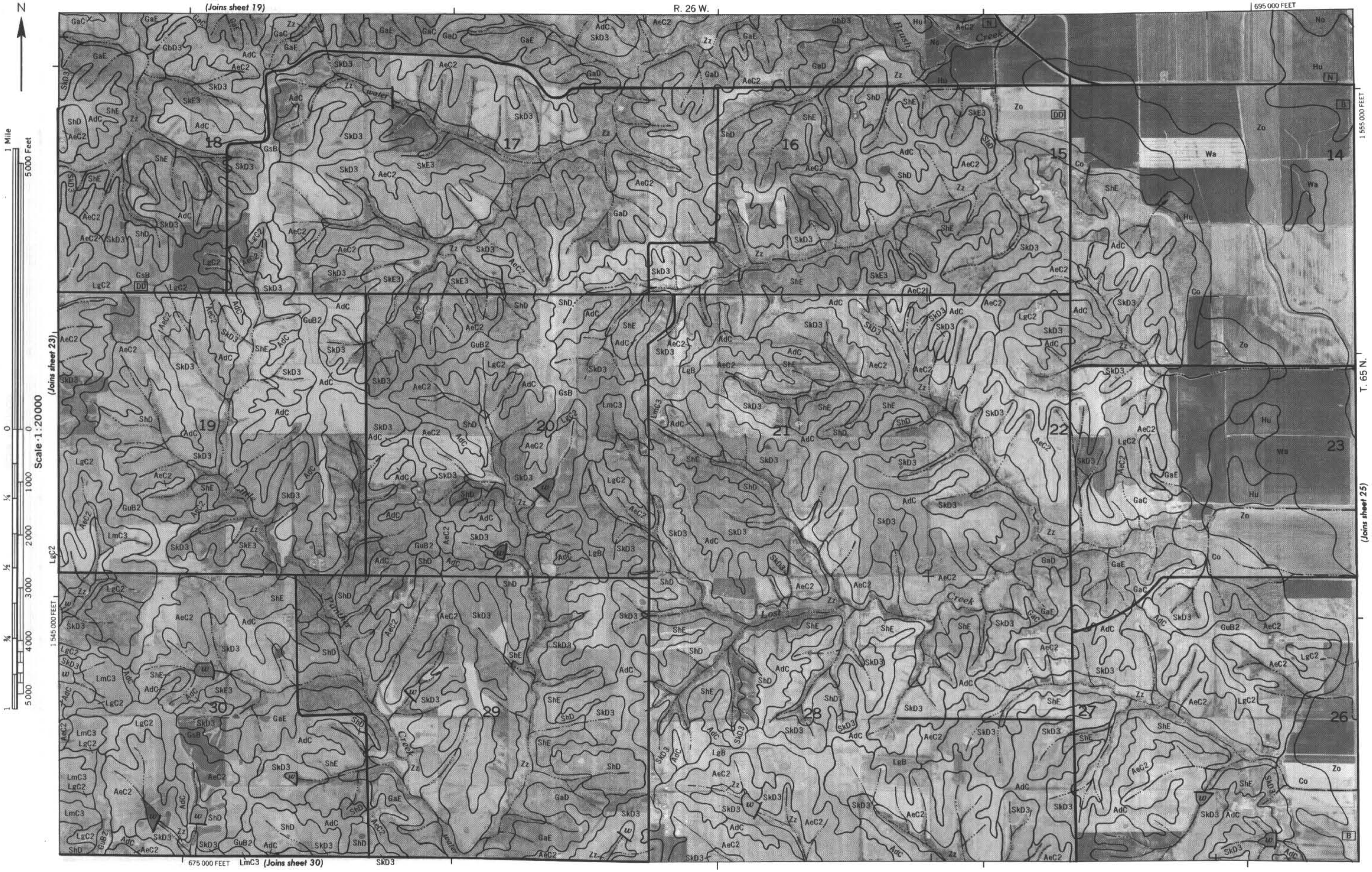
HARRISON COUNTY, MISSOURI NO. 22

HARRISON COUNTY, MISSOURI — SHEET NUMBER 23



HARRISON COUNTY, MISSOURI NO. 23

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

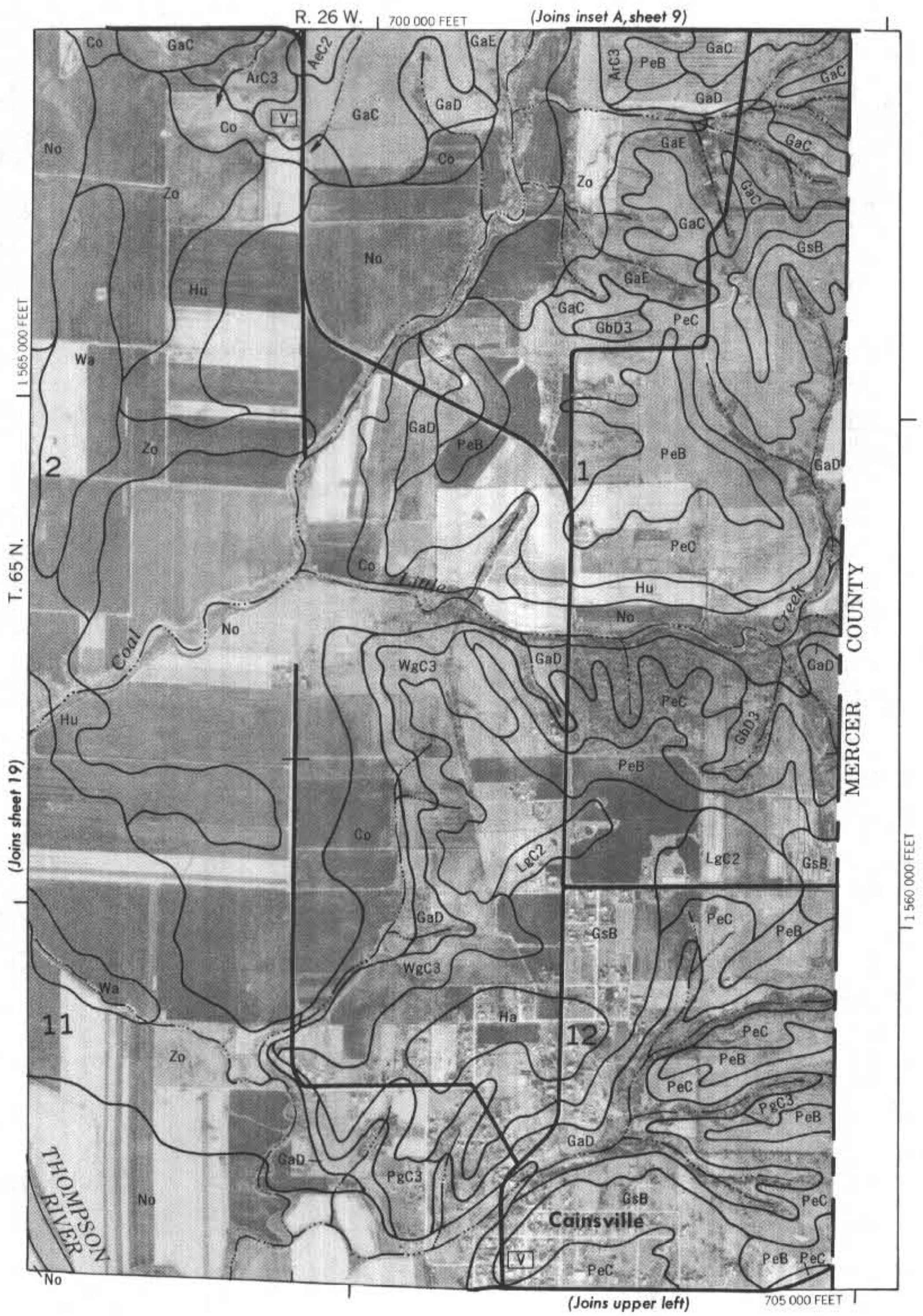


This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 24

HARRISON COUNTY, MISSOURI NO. 25

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



1 545 000 FEET

720 000 FEET

N

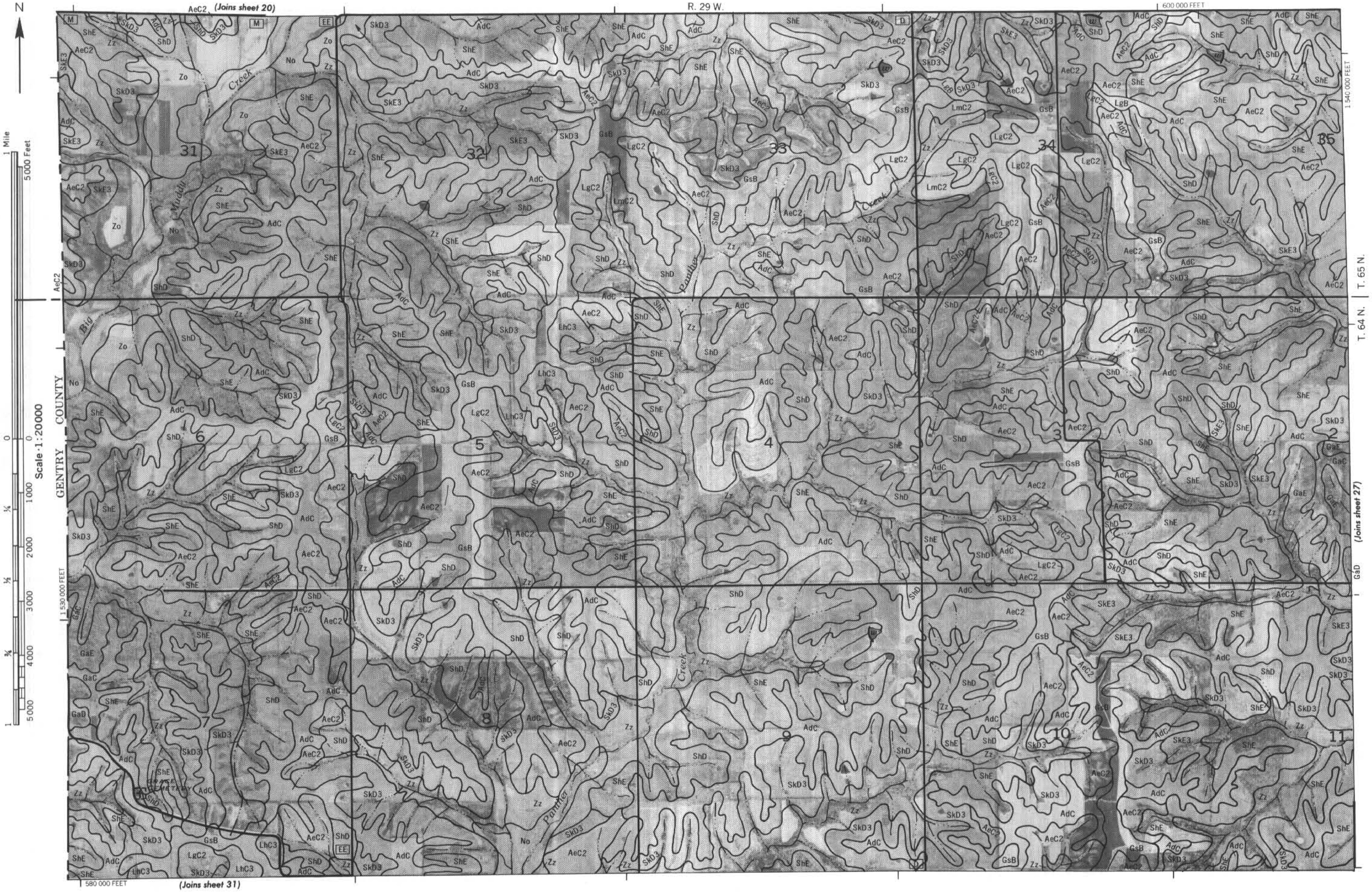
1 Mile

5000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 26

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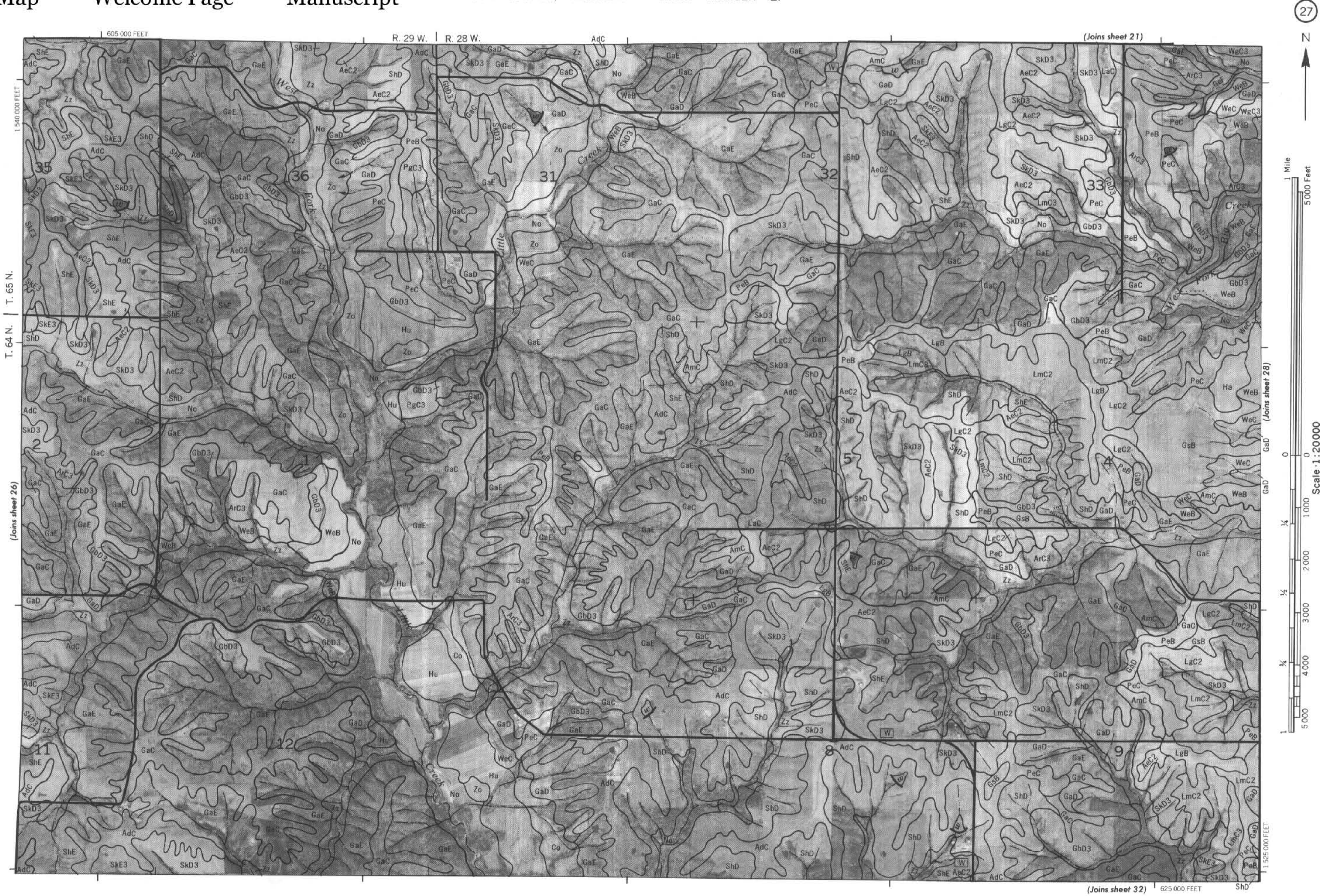
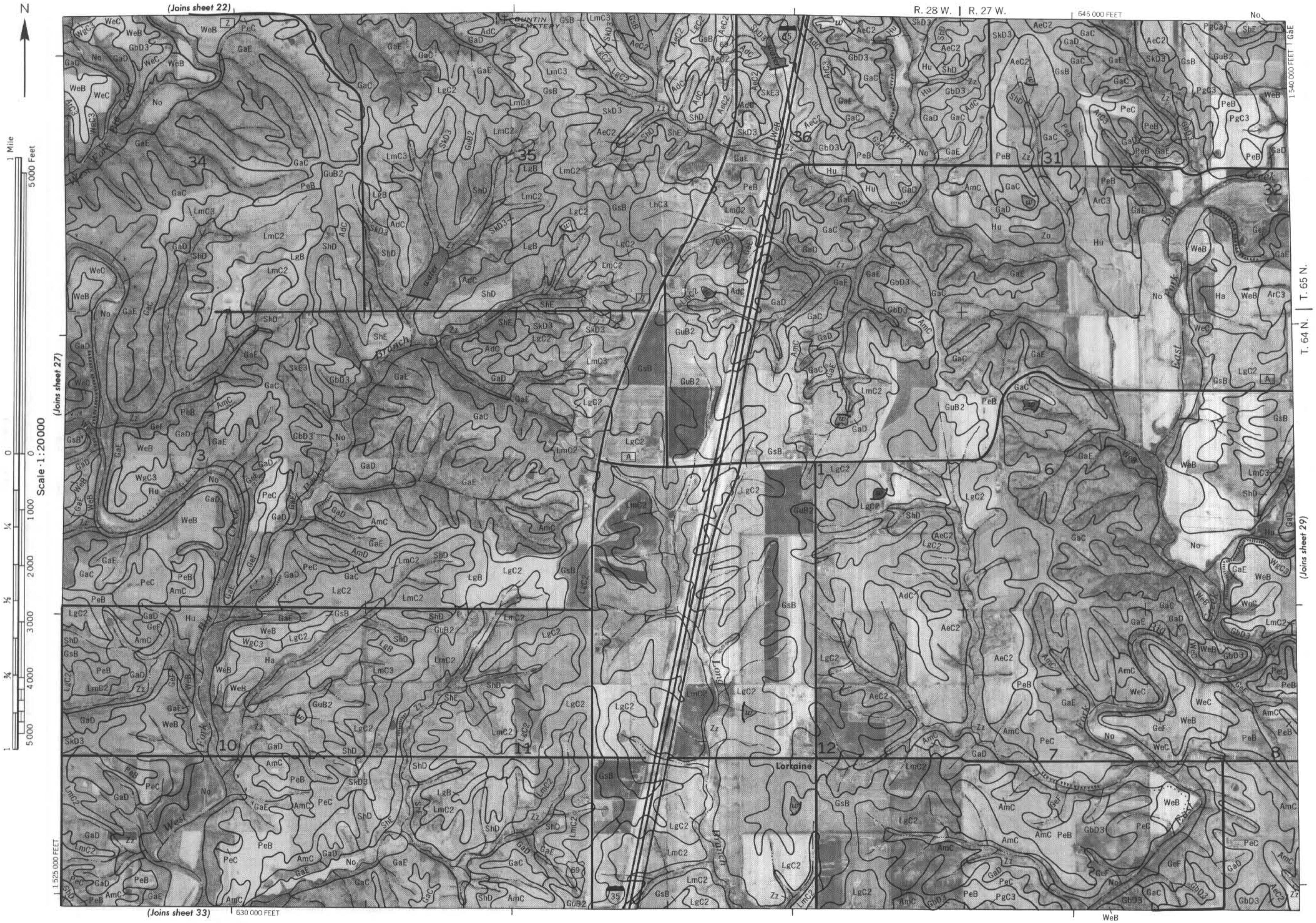


HARRISON COUNTY, MISSOURI NO. 27

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

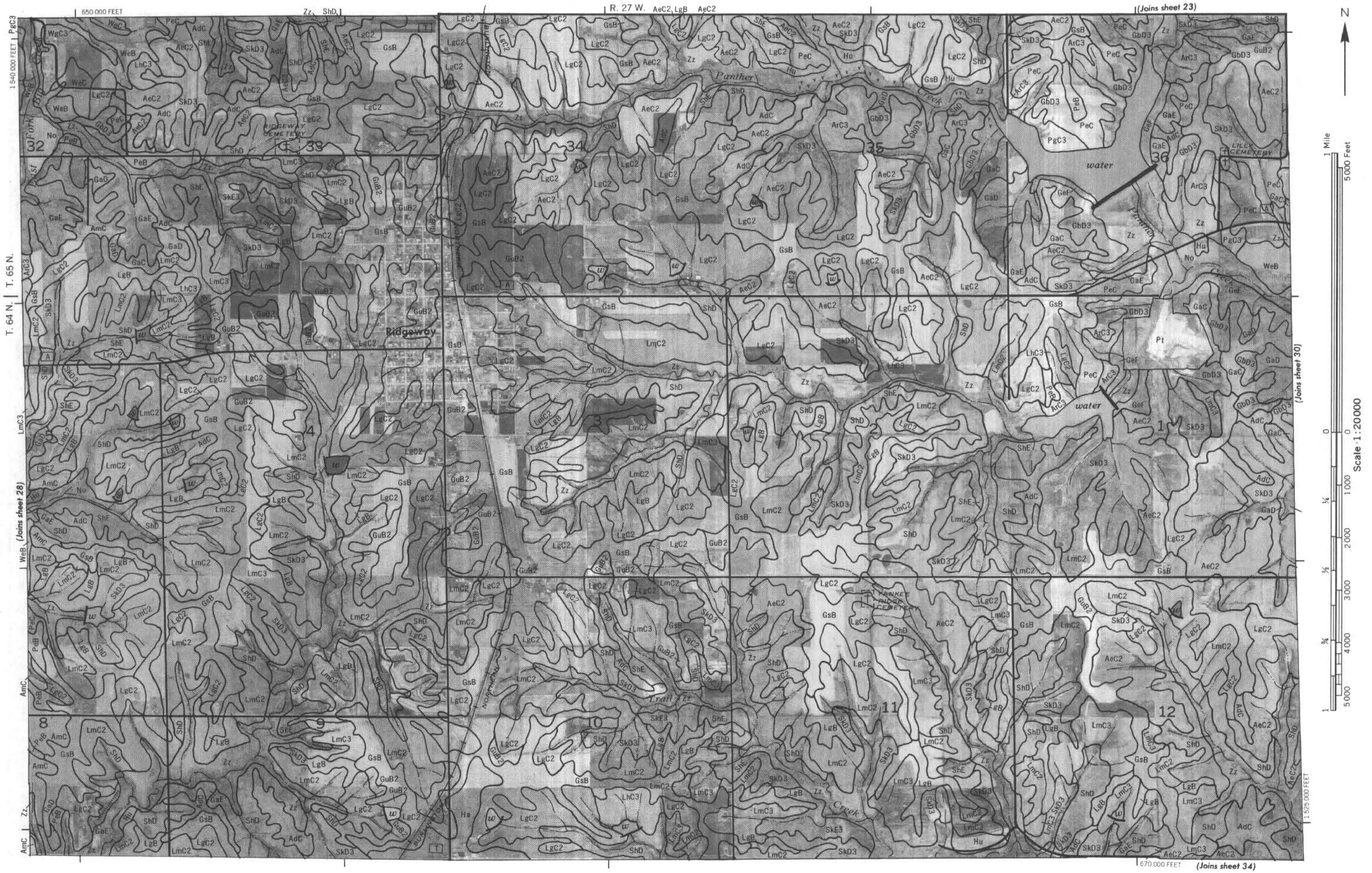
(28)

Index Map Welcome Page Manuscript HARRISON COUNTY, MISSOURI — SHEET NUMBER 28



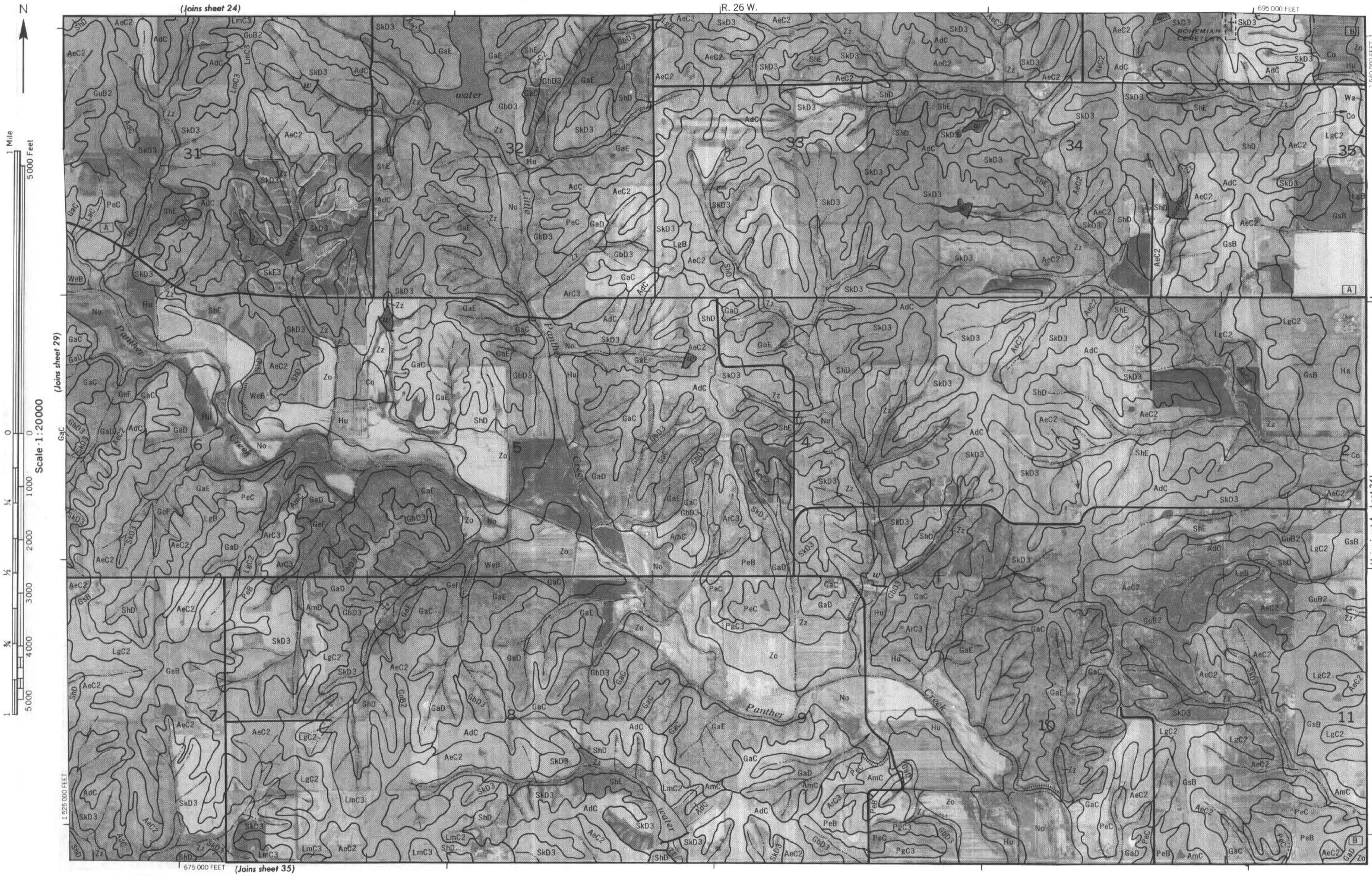
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 28



HARRISON COUNTY, MISSOURI NO. 29

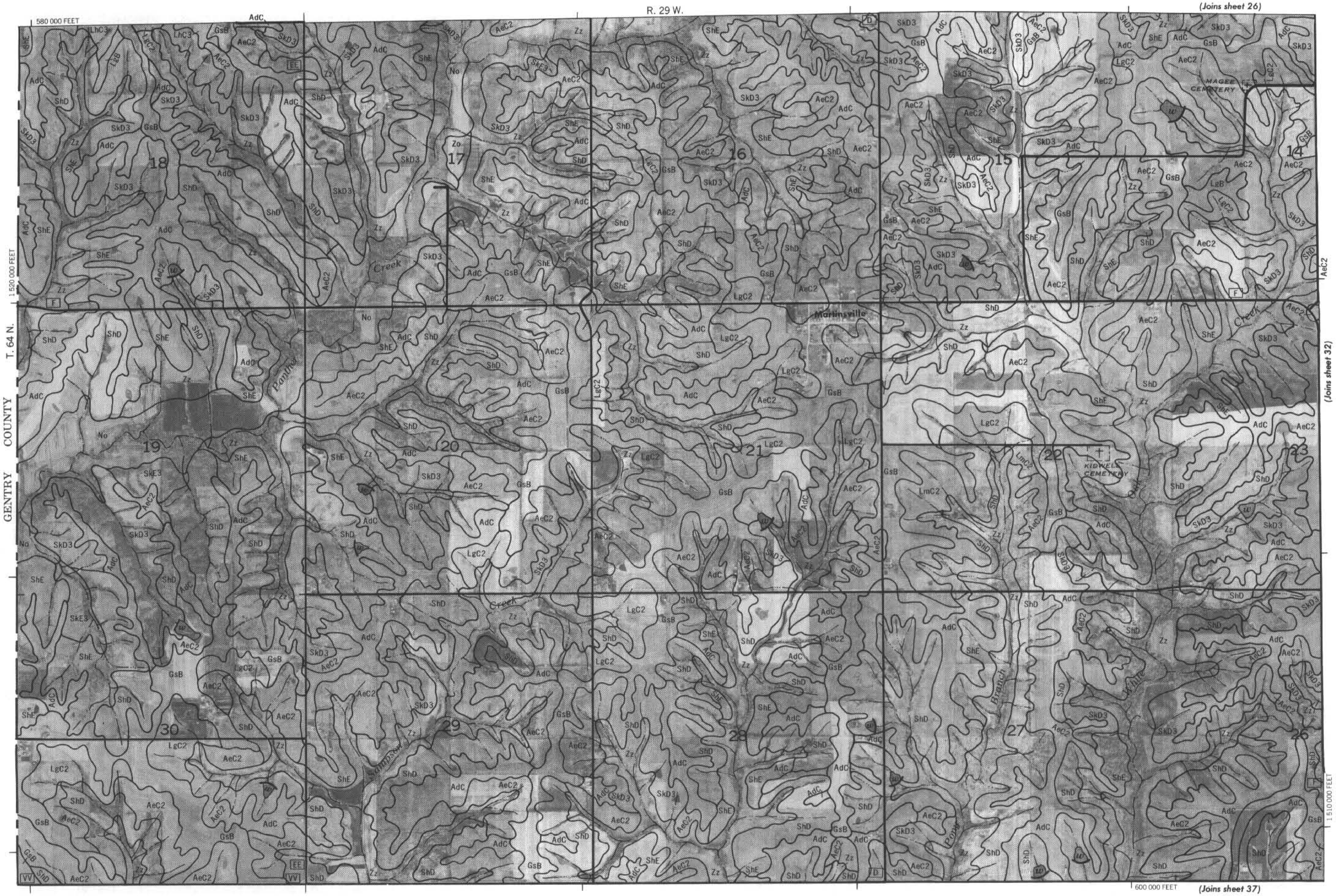
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 30

HARRISON COUNTY, MISSOURI — SHEET NUMBER 31



31

N

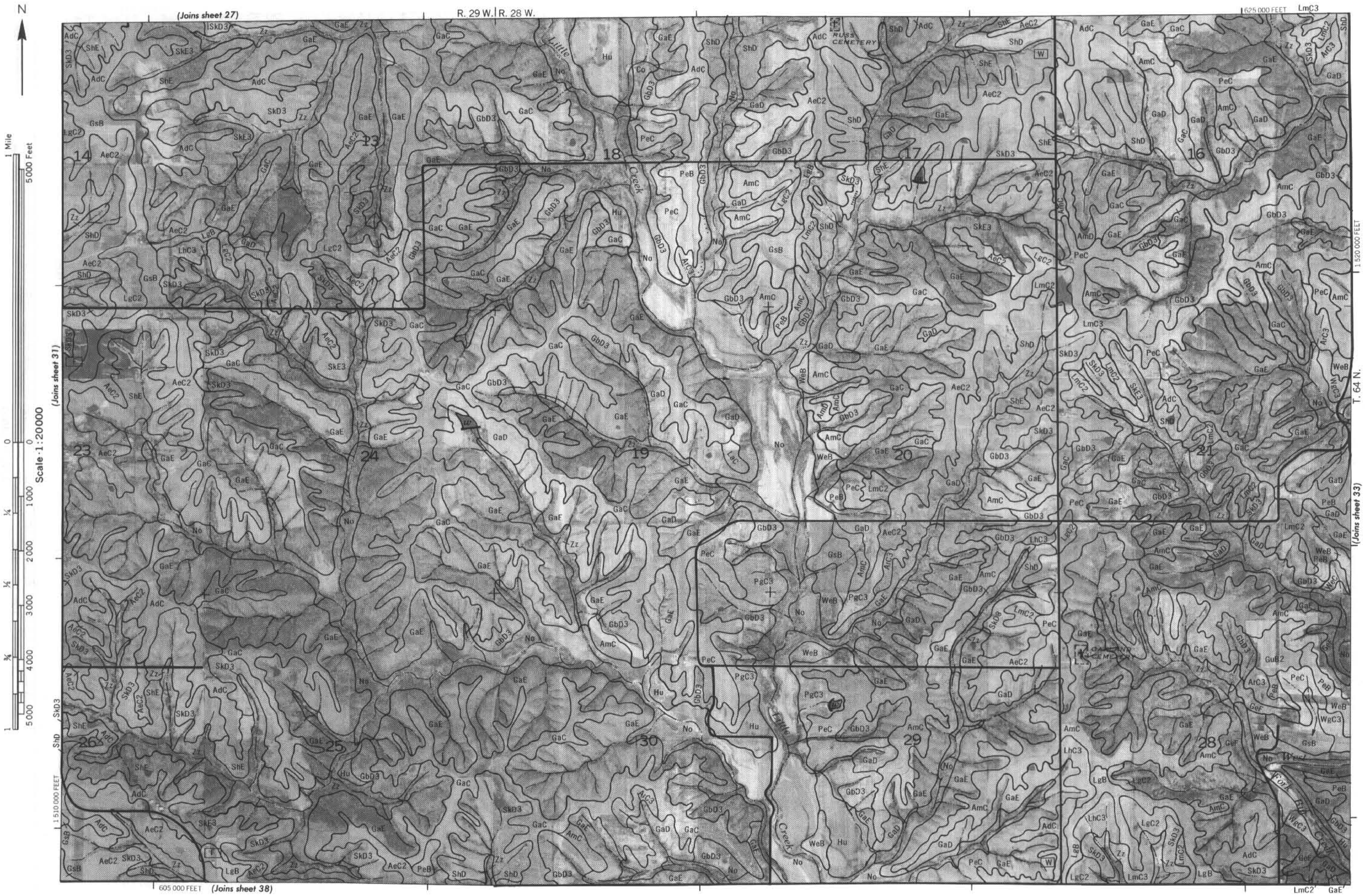
1 Mile

5000 Feet

Scale 1:20000

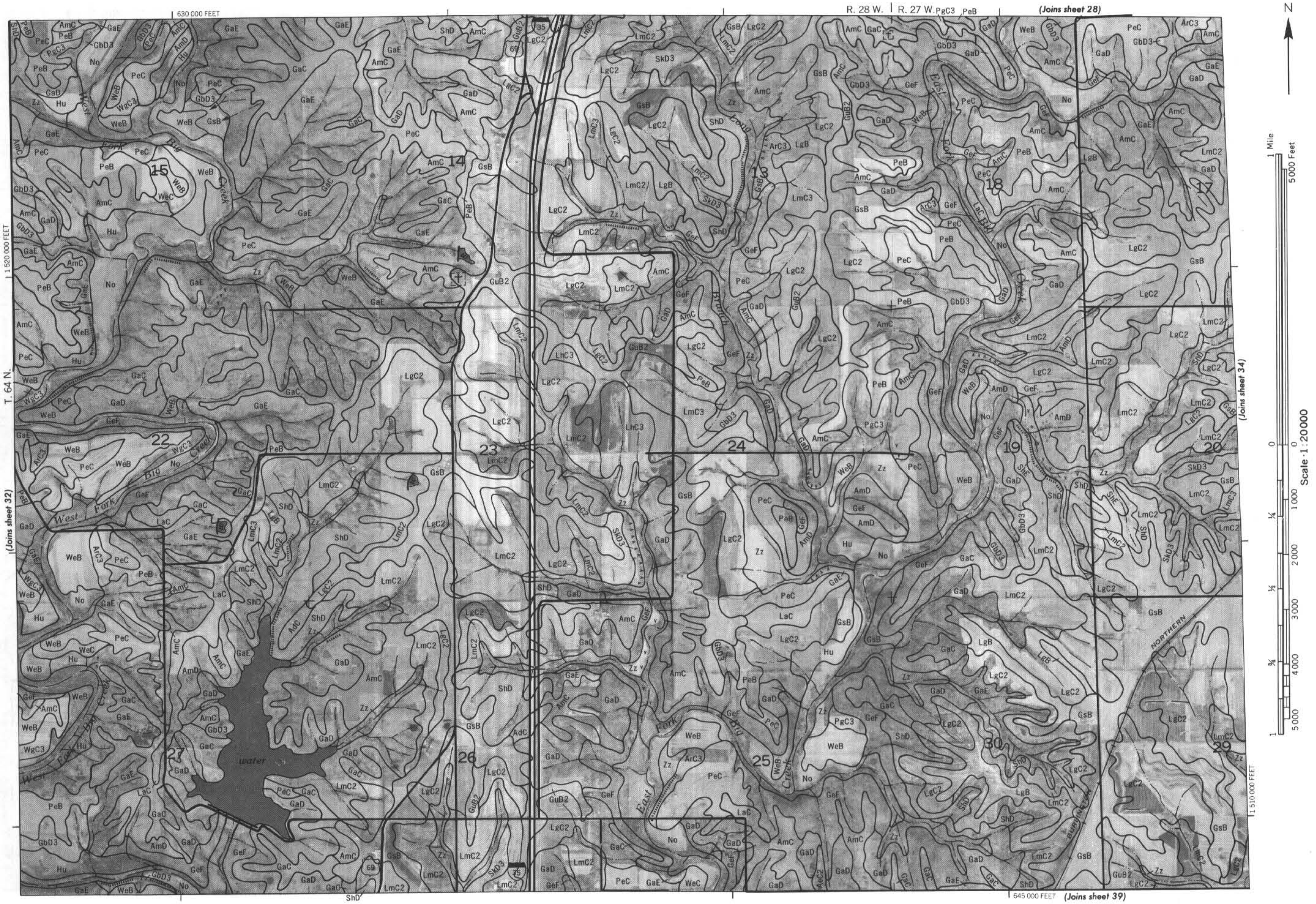
HARRISON COUNTY, MISSOURI NO. 31

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



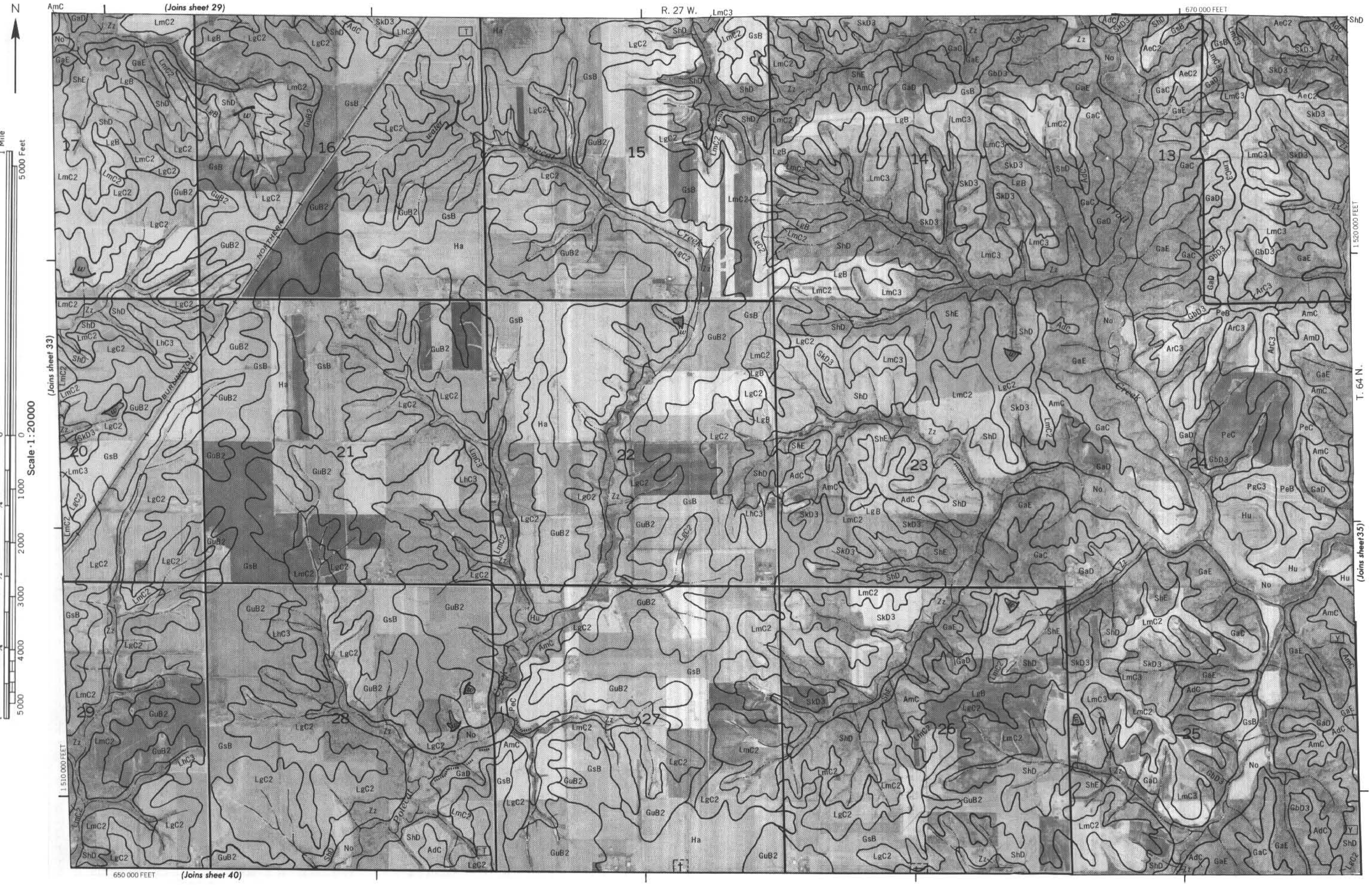
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 32



HARRISON COUNTY, MISSOURI NO. 33

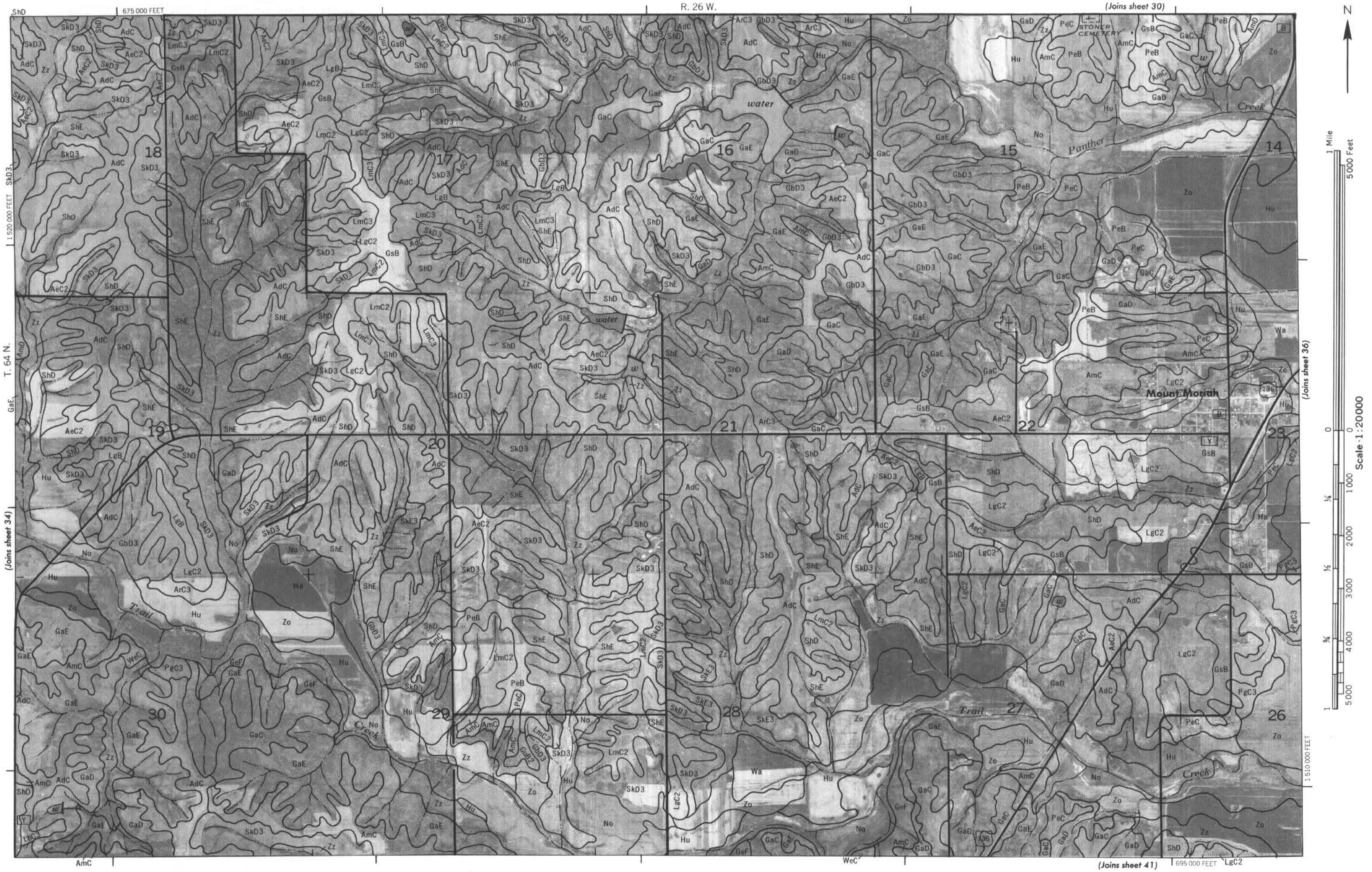
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

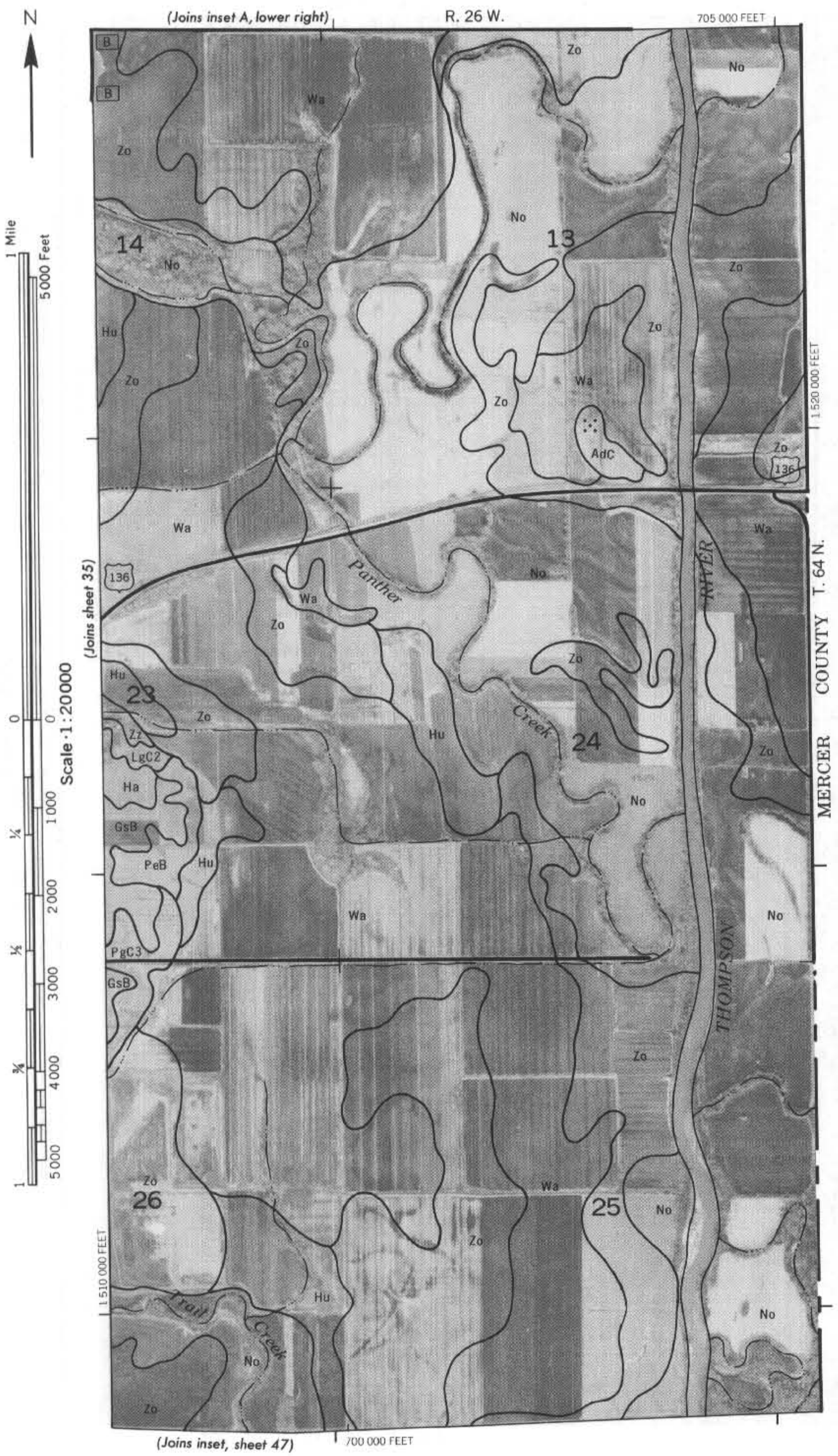
HARRISON COUNTY, MISSOURI NO. 34

HARRISON COUNTY, MISSOURI — SHEET NUMBER 35



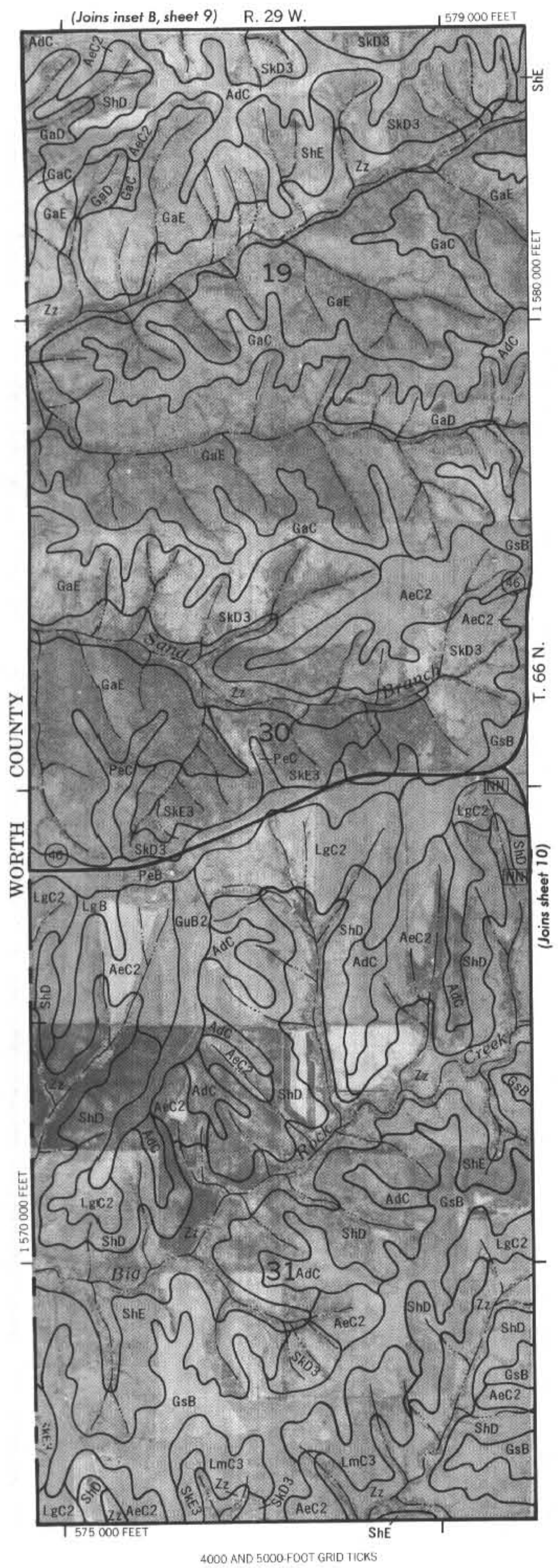
HARRISON COUNTY, MISSOURI NO. 35

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



INSET A

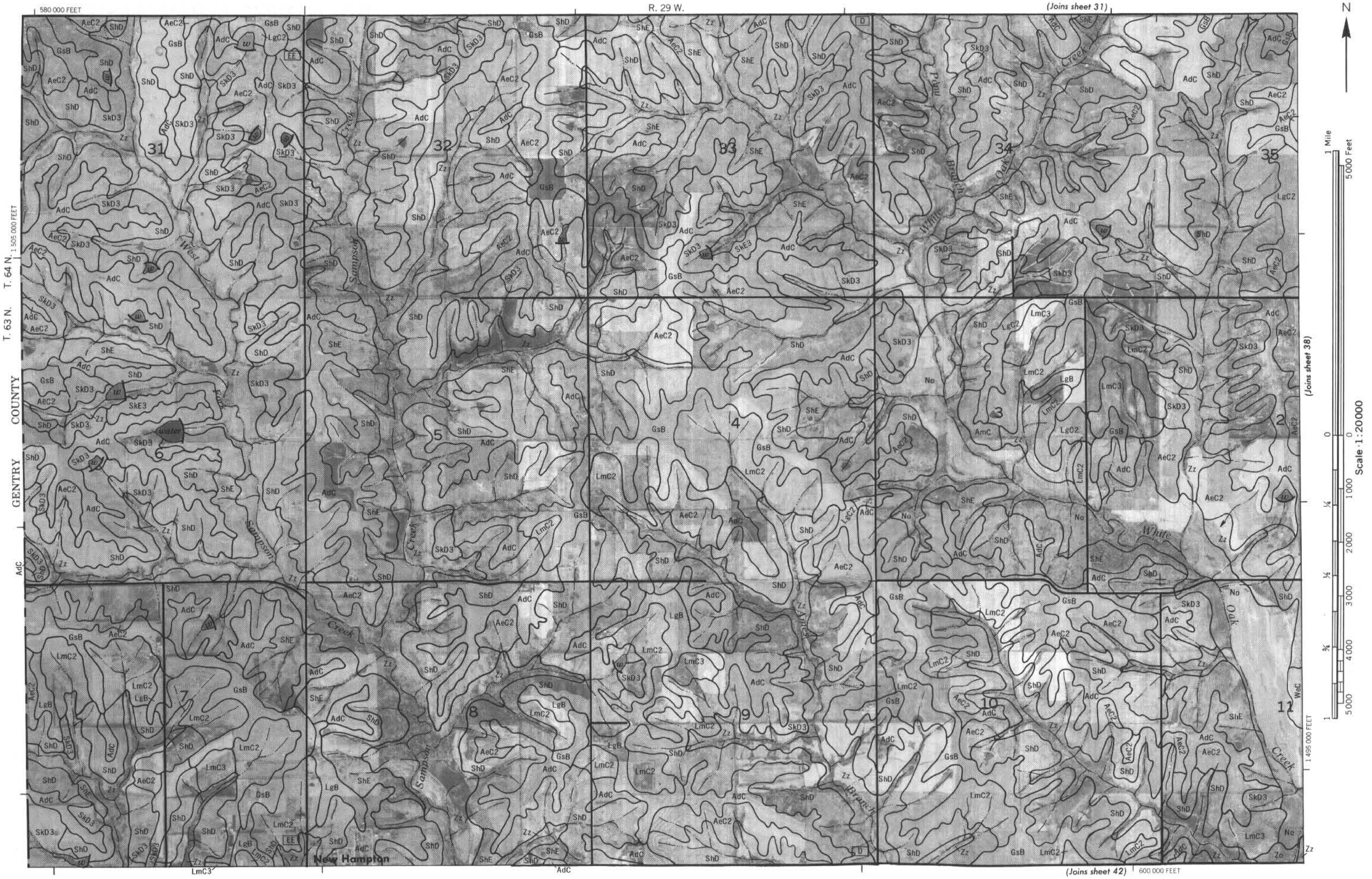
INSET B



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 36

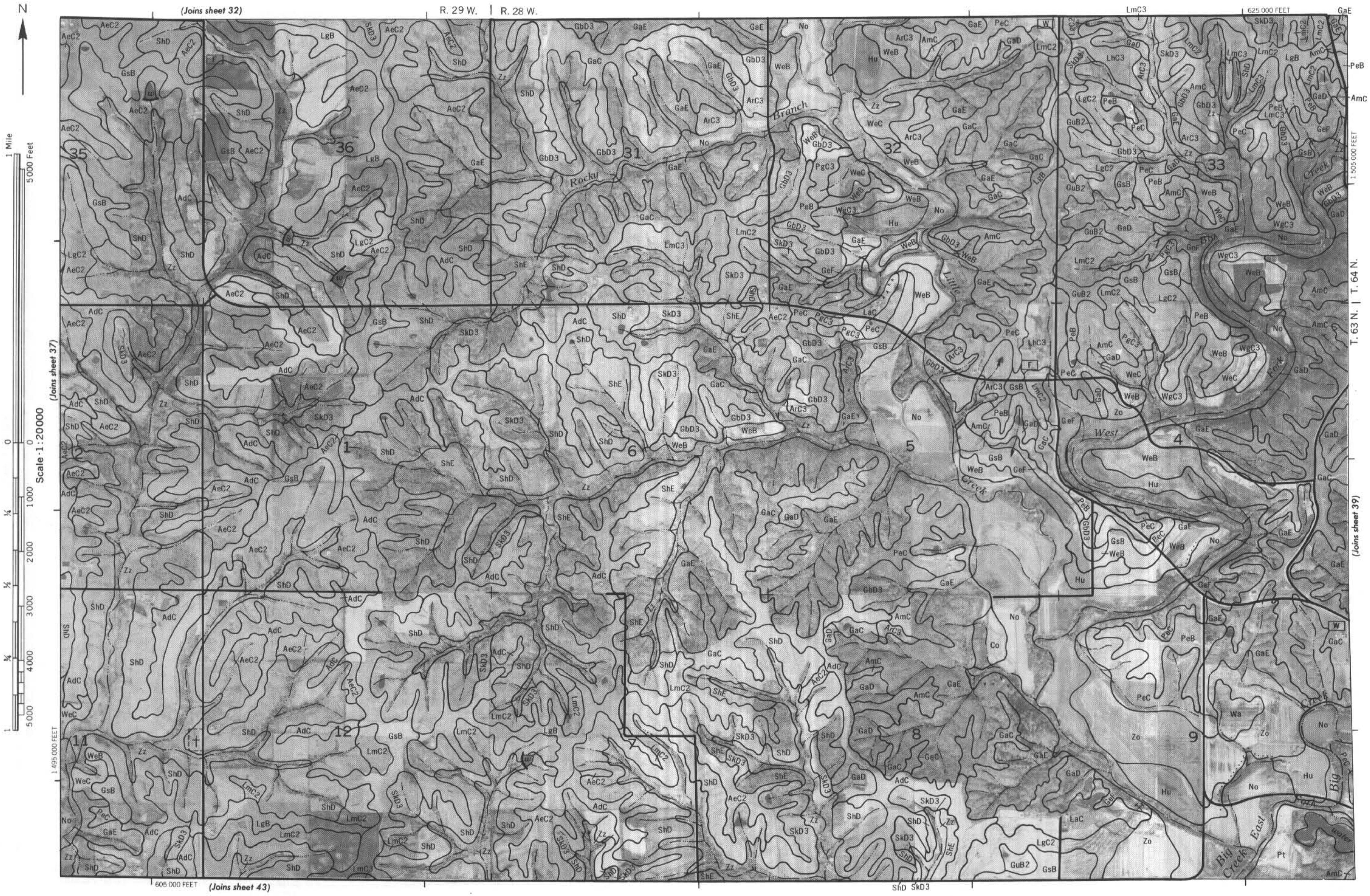
HARRISON COUNTY, MISSOURI — SHEET NUMBER 37



HARRISON COUNTY, MISSOURI NO. 37

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

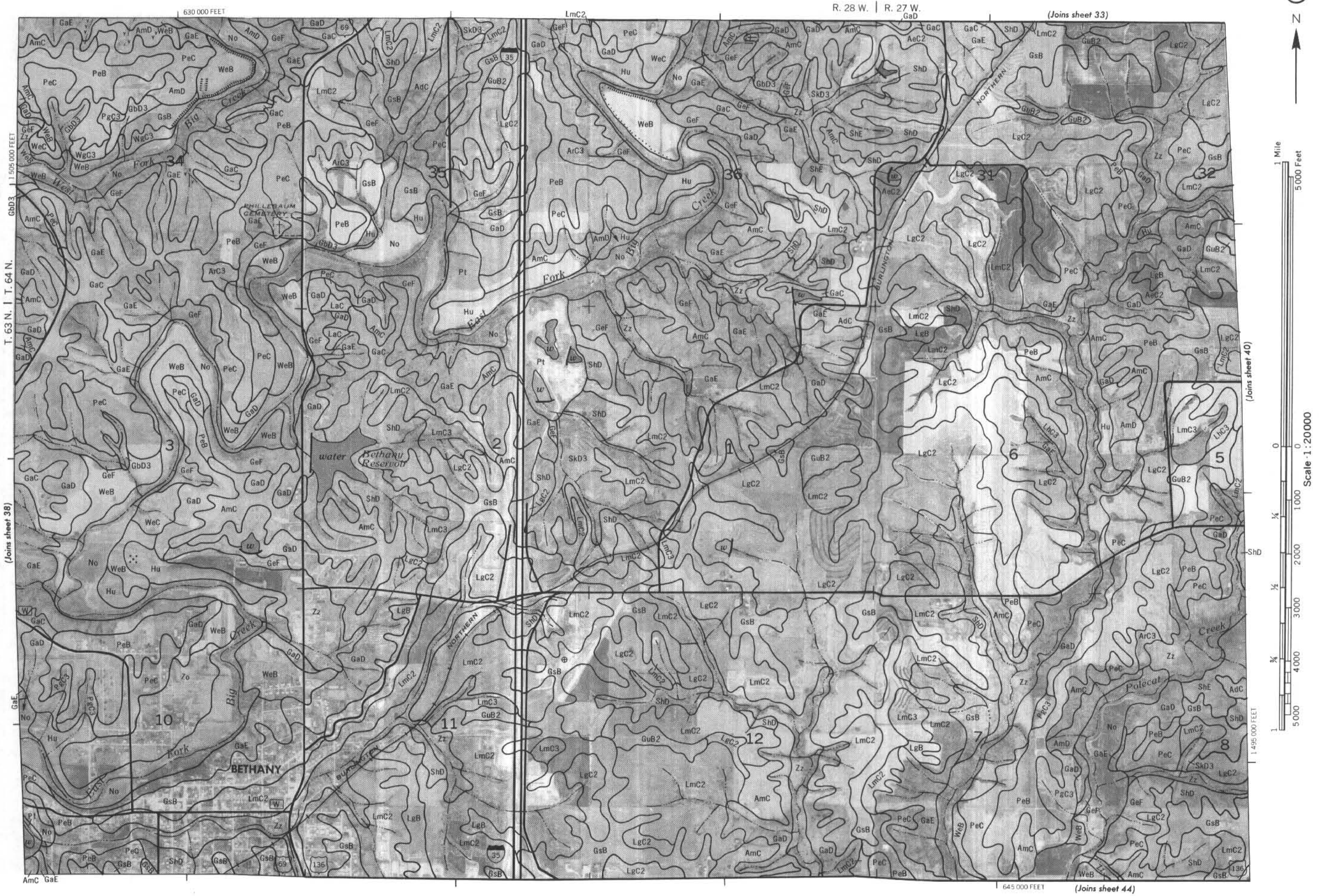
HARRISON COUNTY, MISSOURI — SHEET NUMBER 38



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

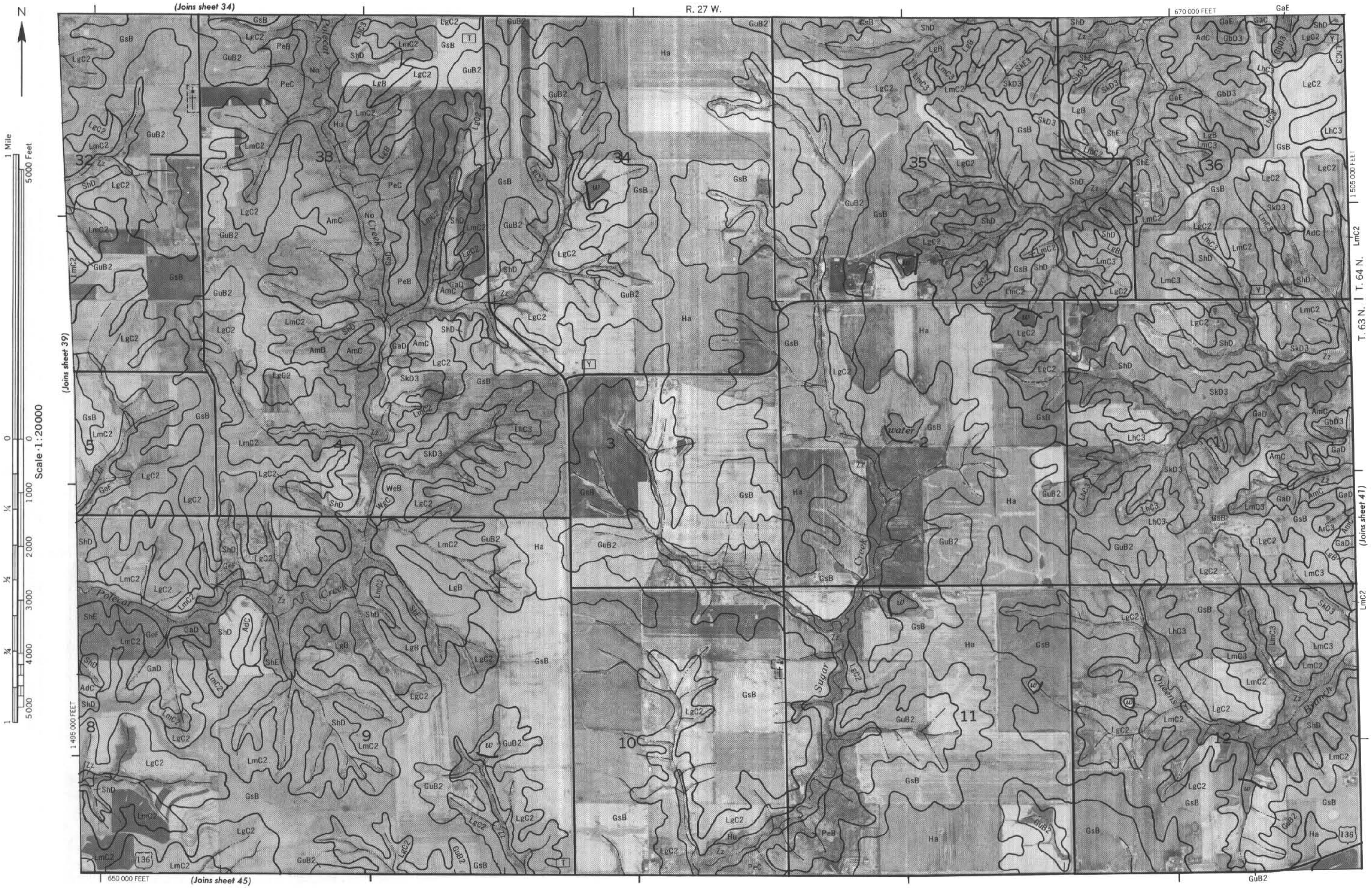
HARRISON COUNTY, MISSOURI NO. 38

HARRISON COUNTY, MISSOURI — SHEET NUMBER 39



HARRISON COUNTY, MISSOURI NO. 39

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 40

HARRISON COUNTY, MISSOURI — SHEET NUMBER 41

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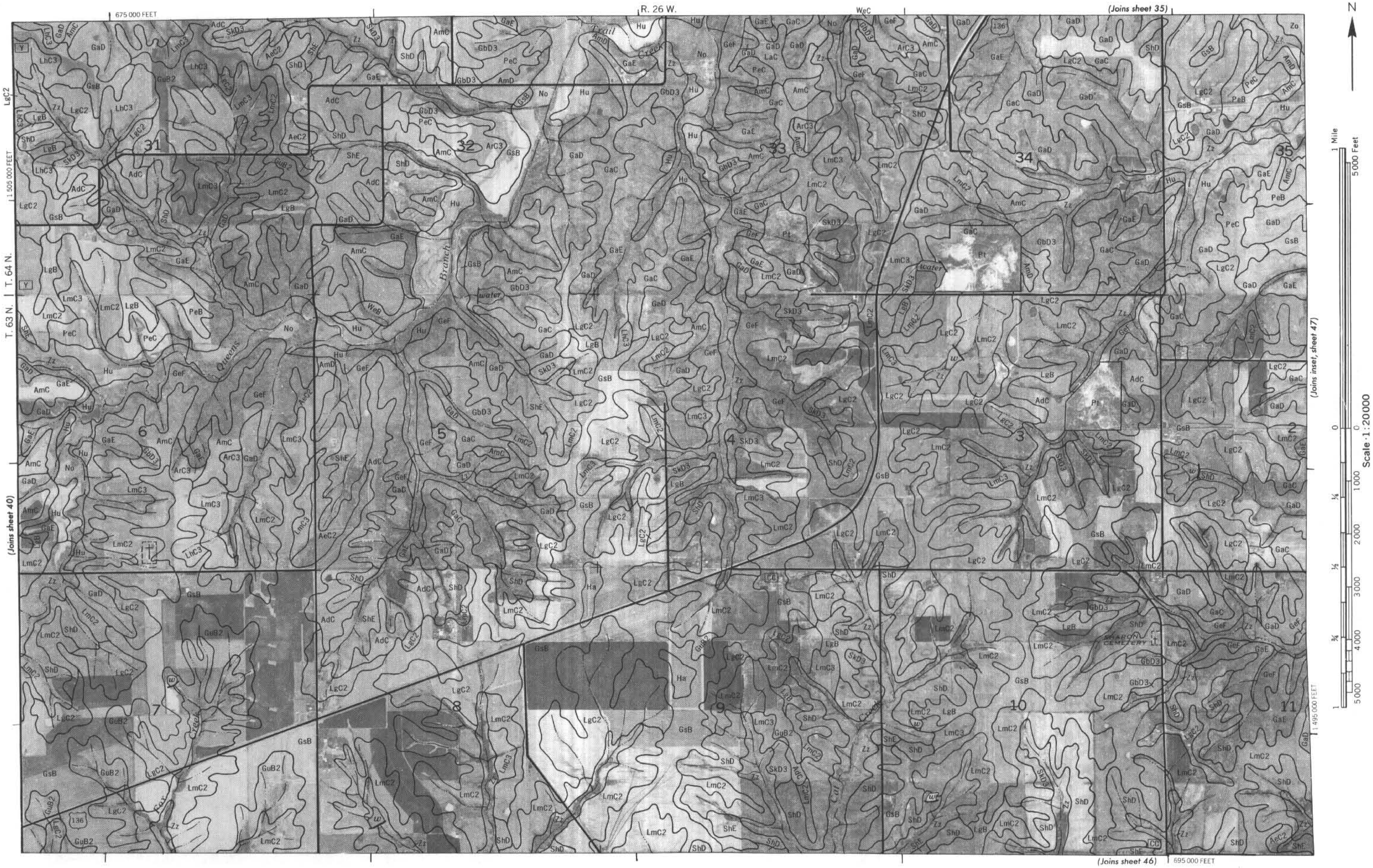
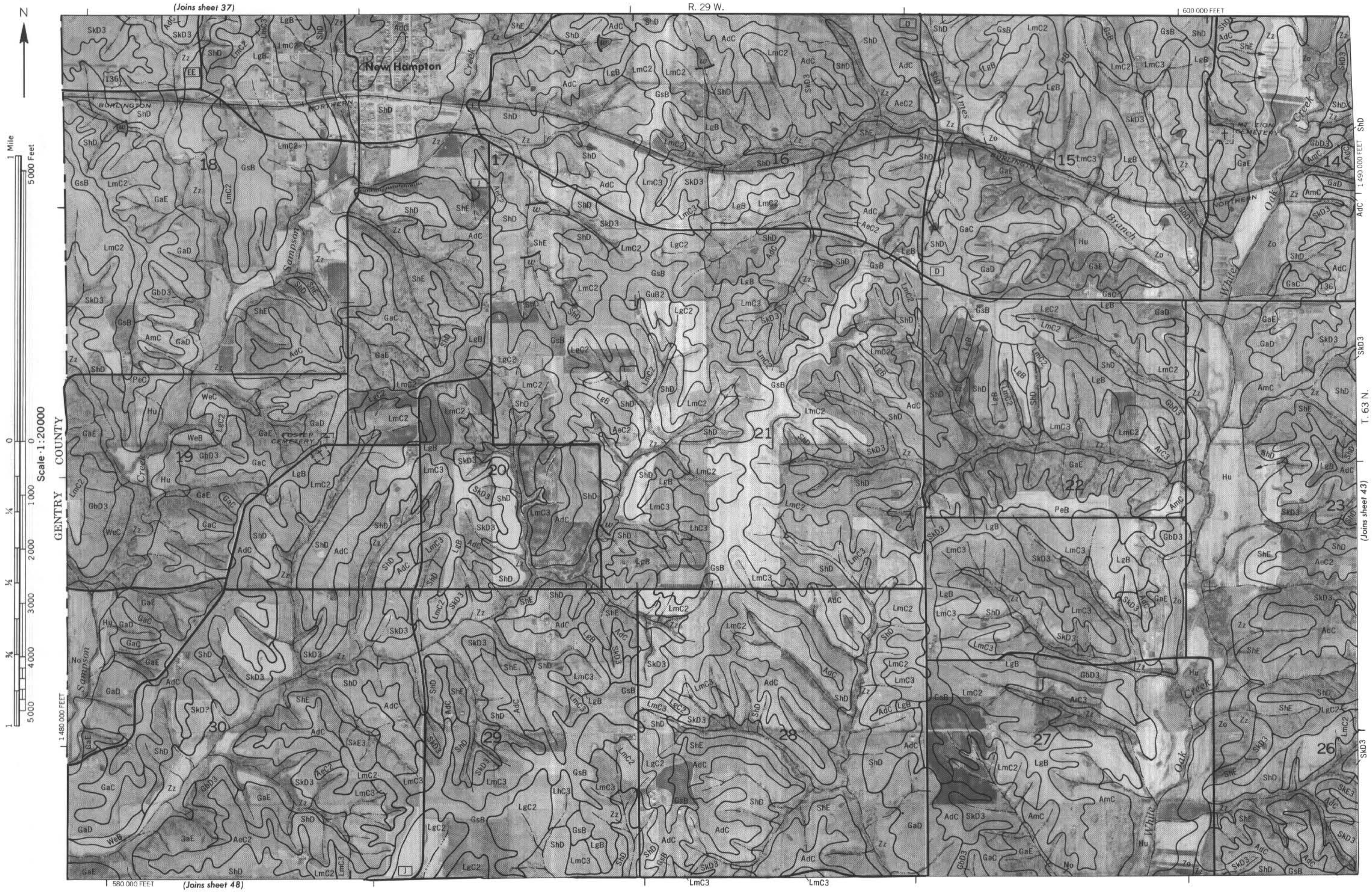
HARRISON COUNTY, MISSOURI NO. 41

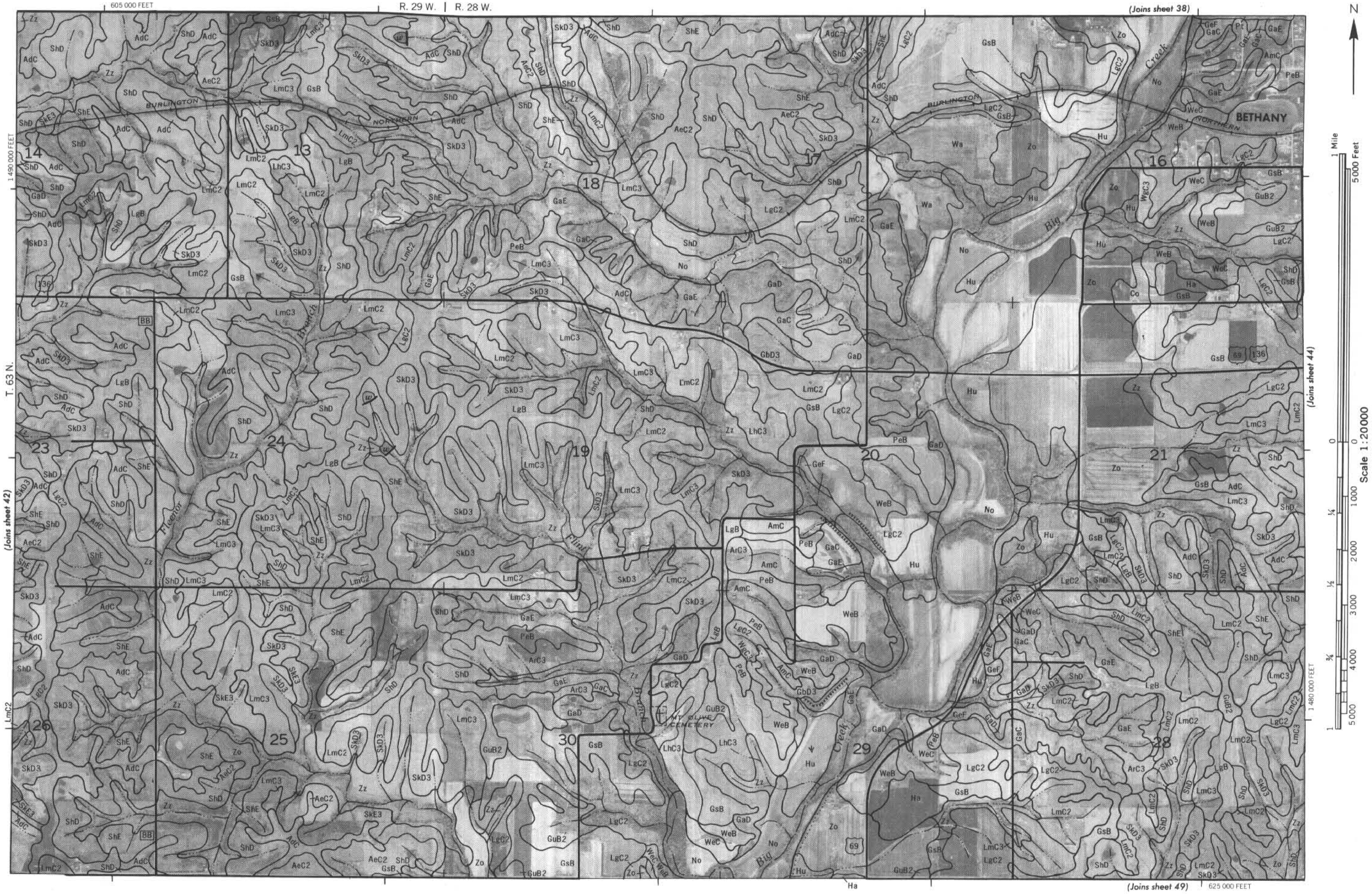
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





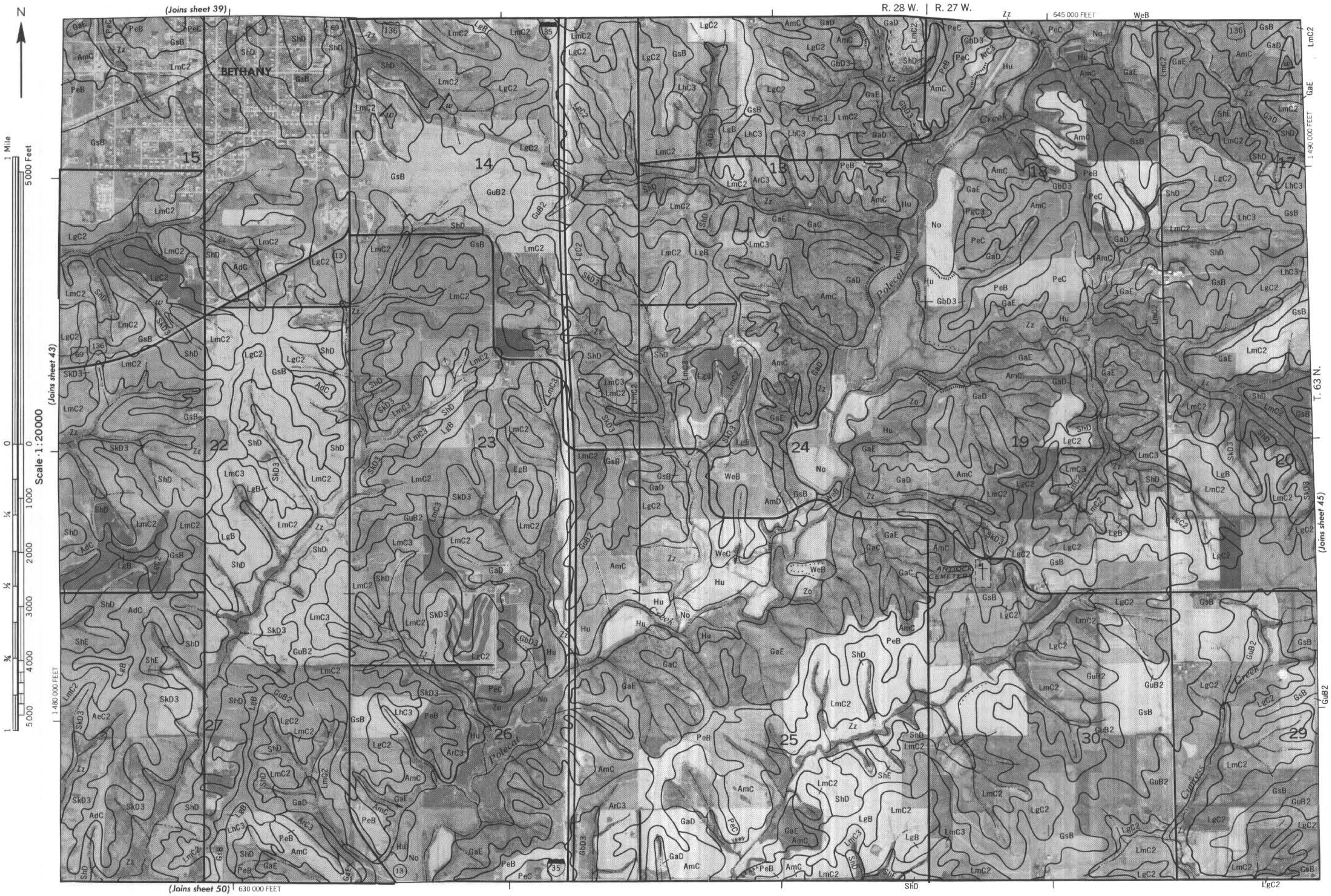
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 42



HARRISON COUNTY, MISSOURI NO. 43

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



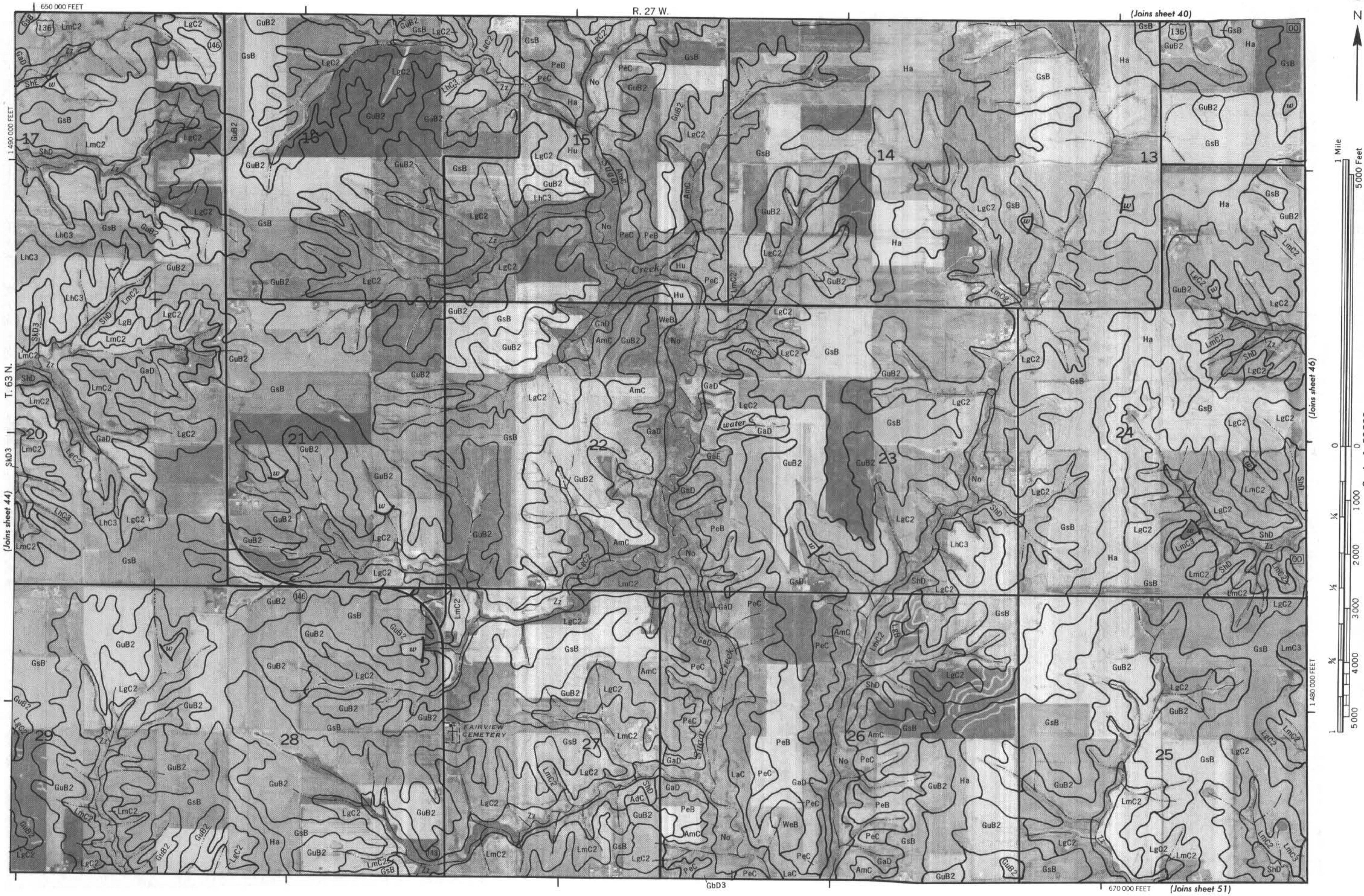
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 44

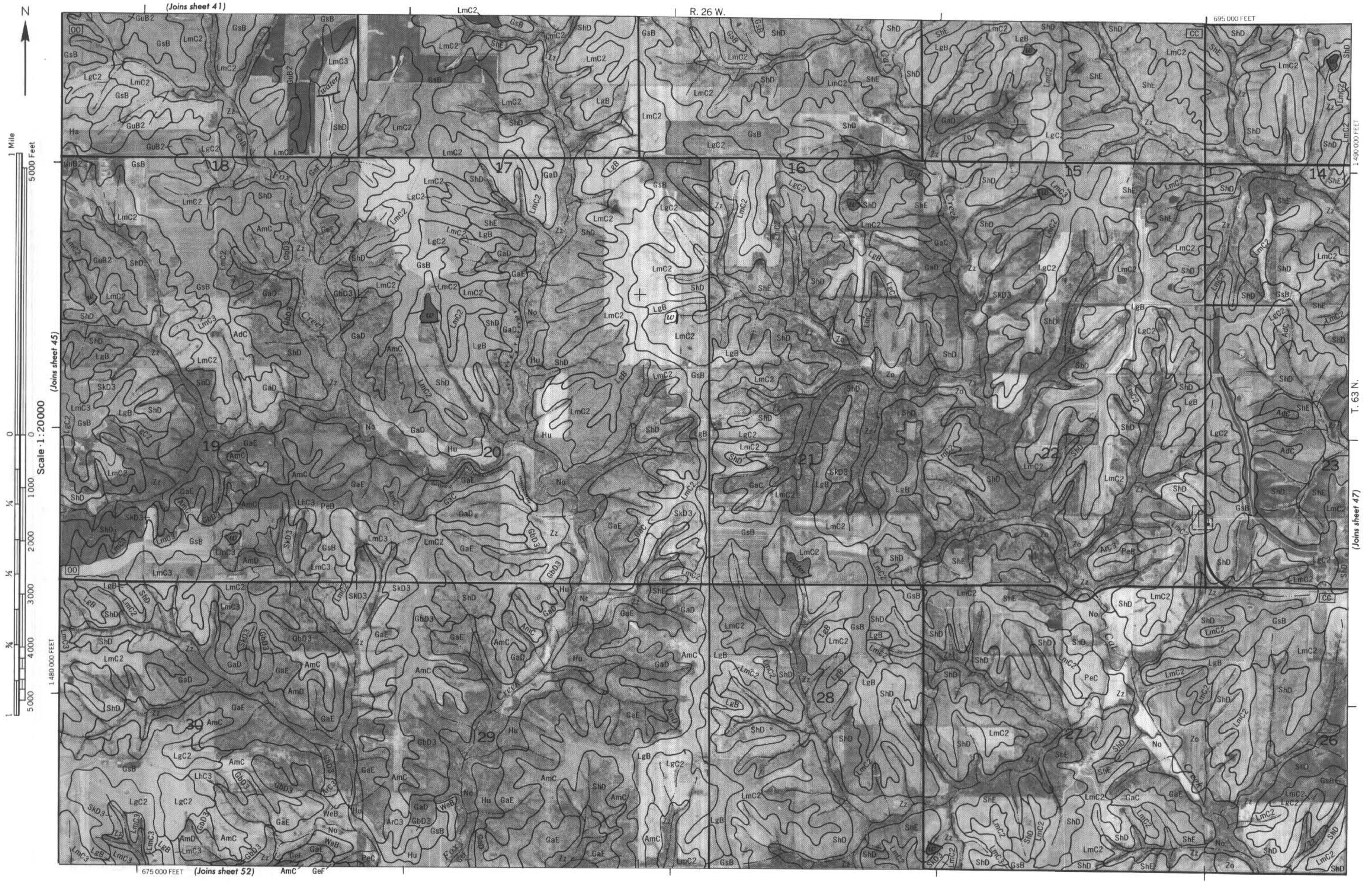
HARRISON COUNTY, MISSOURI — SHEET NUMBER 45

HARRISON COUNTY, MISSOURI NO. 45

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



HARRISON COUNTY, MISSOURI — SHEET NUMBER 46



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 46

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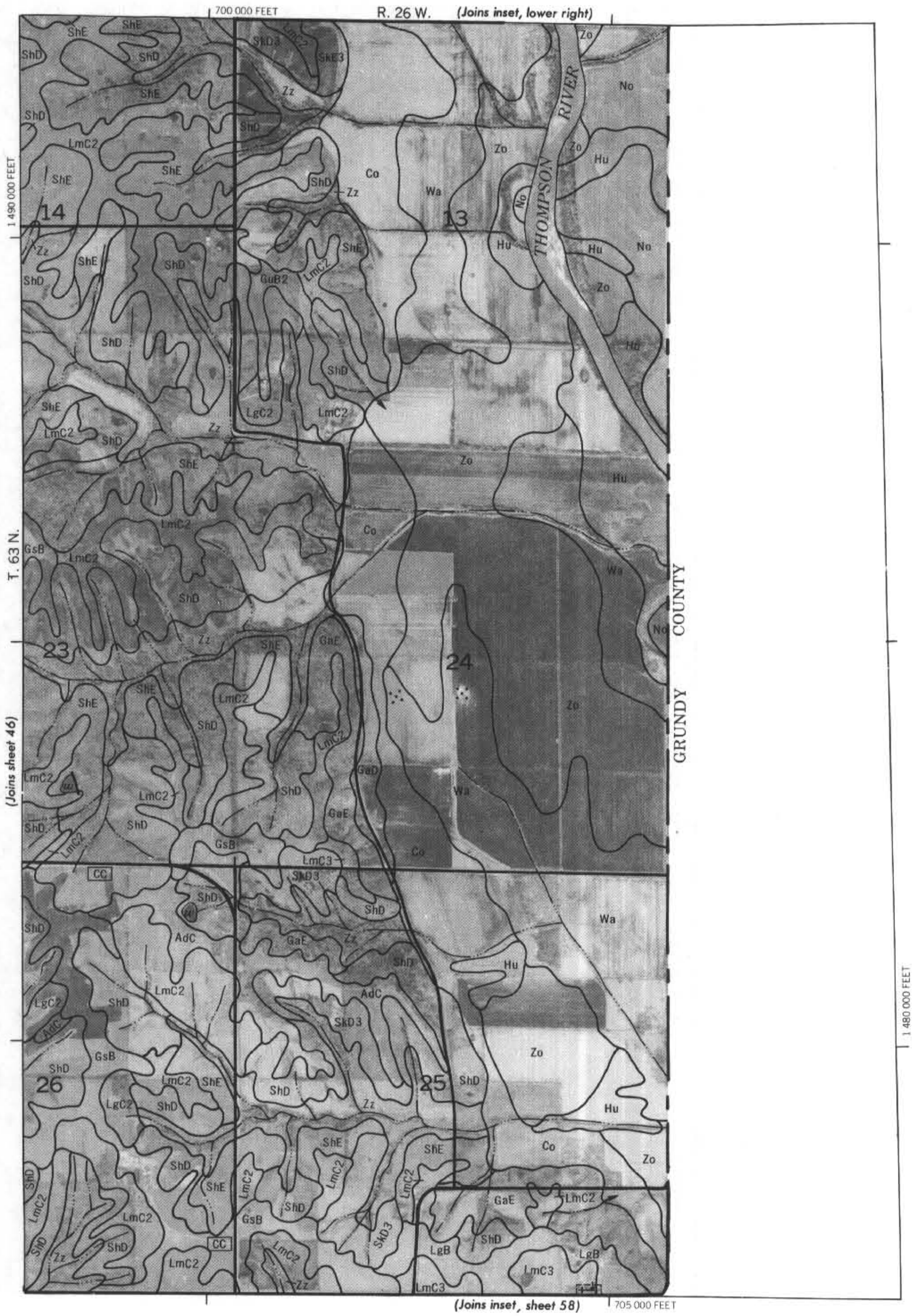
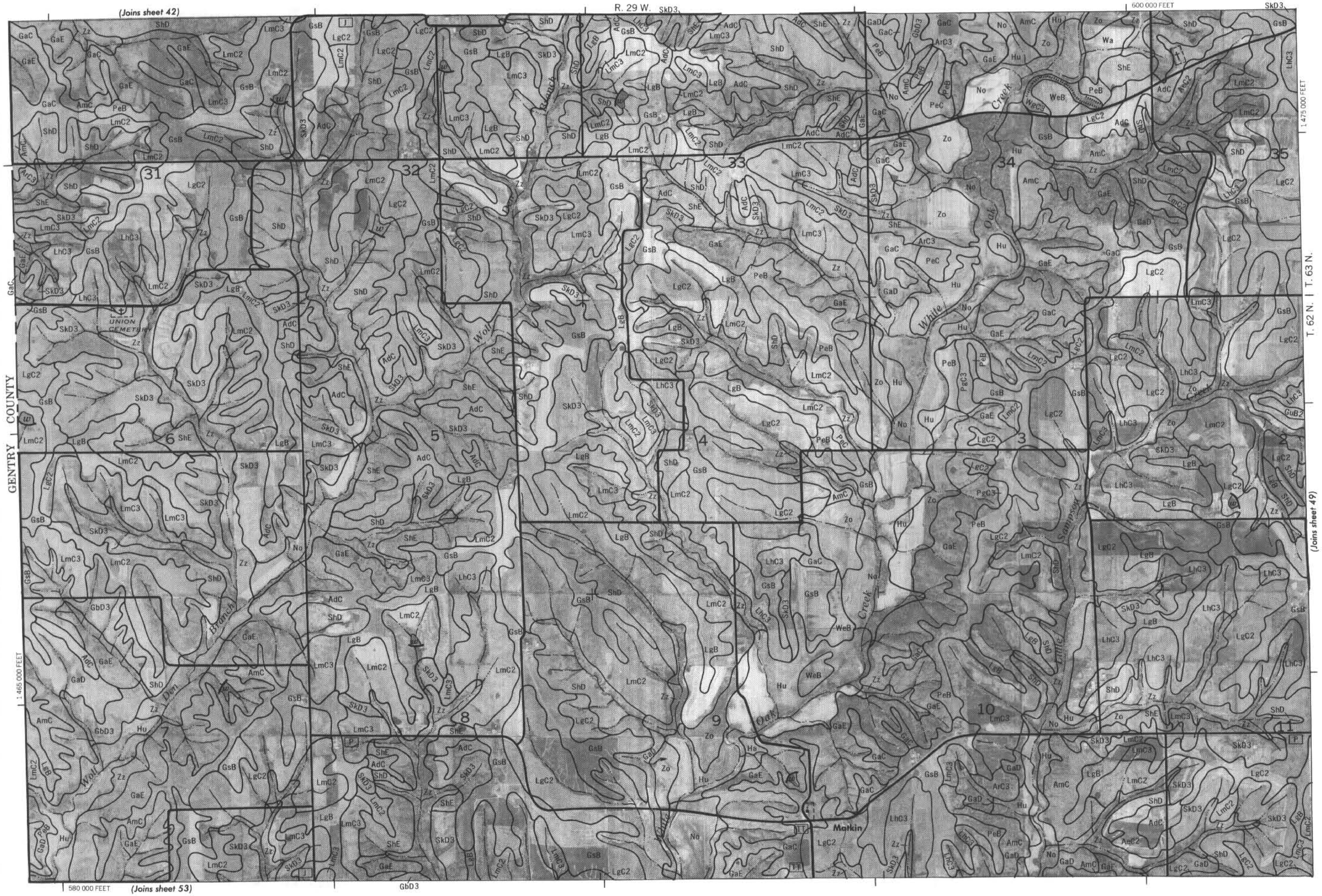
HARRISON COUNTY, MISSOURI NO. 47

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





N

Scale 1:20000
1 Mile
5 000 Feet

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 48

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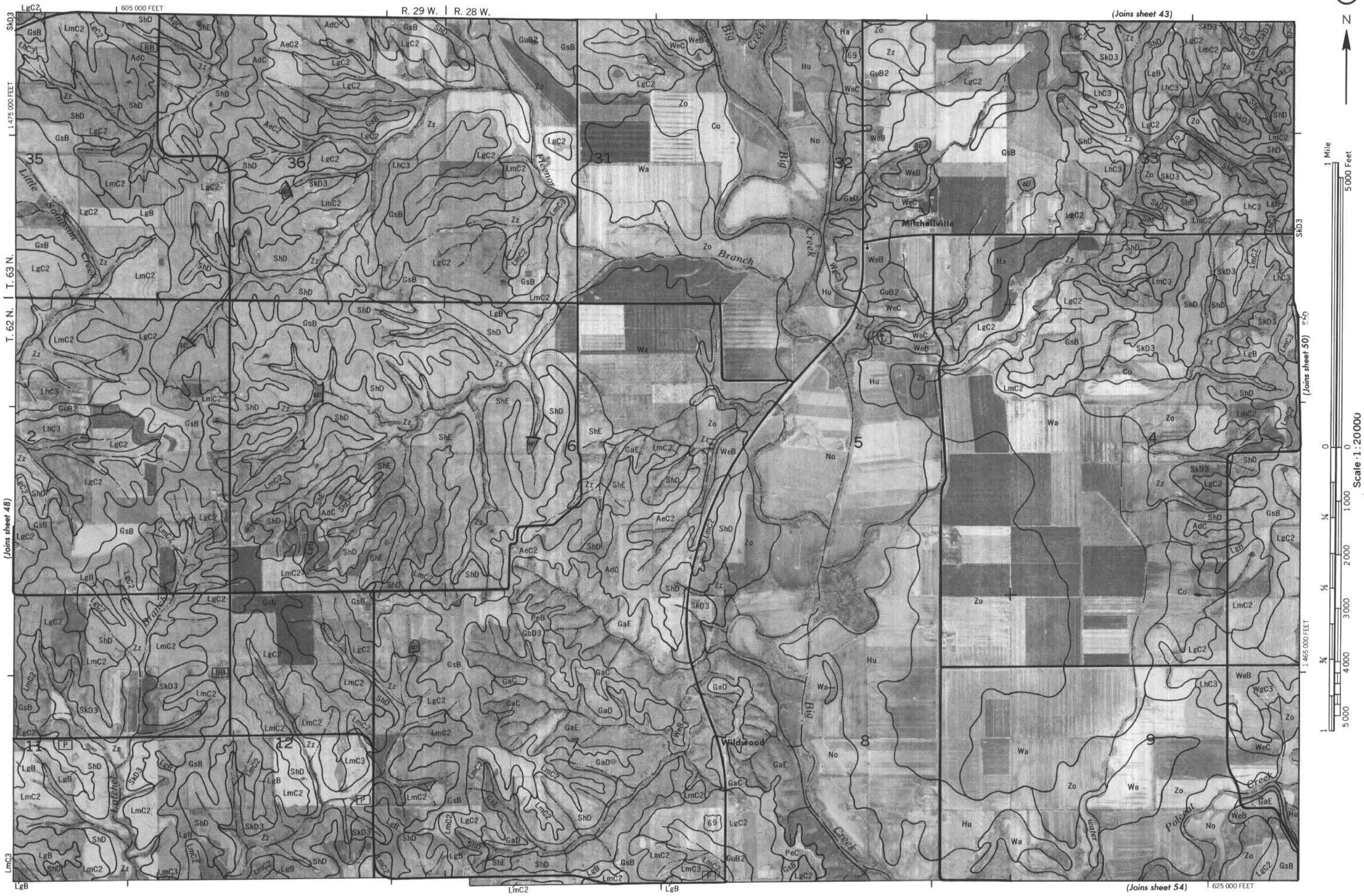
HARRISON COUNTY, MISSOURI NO. 49

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



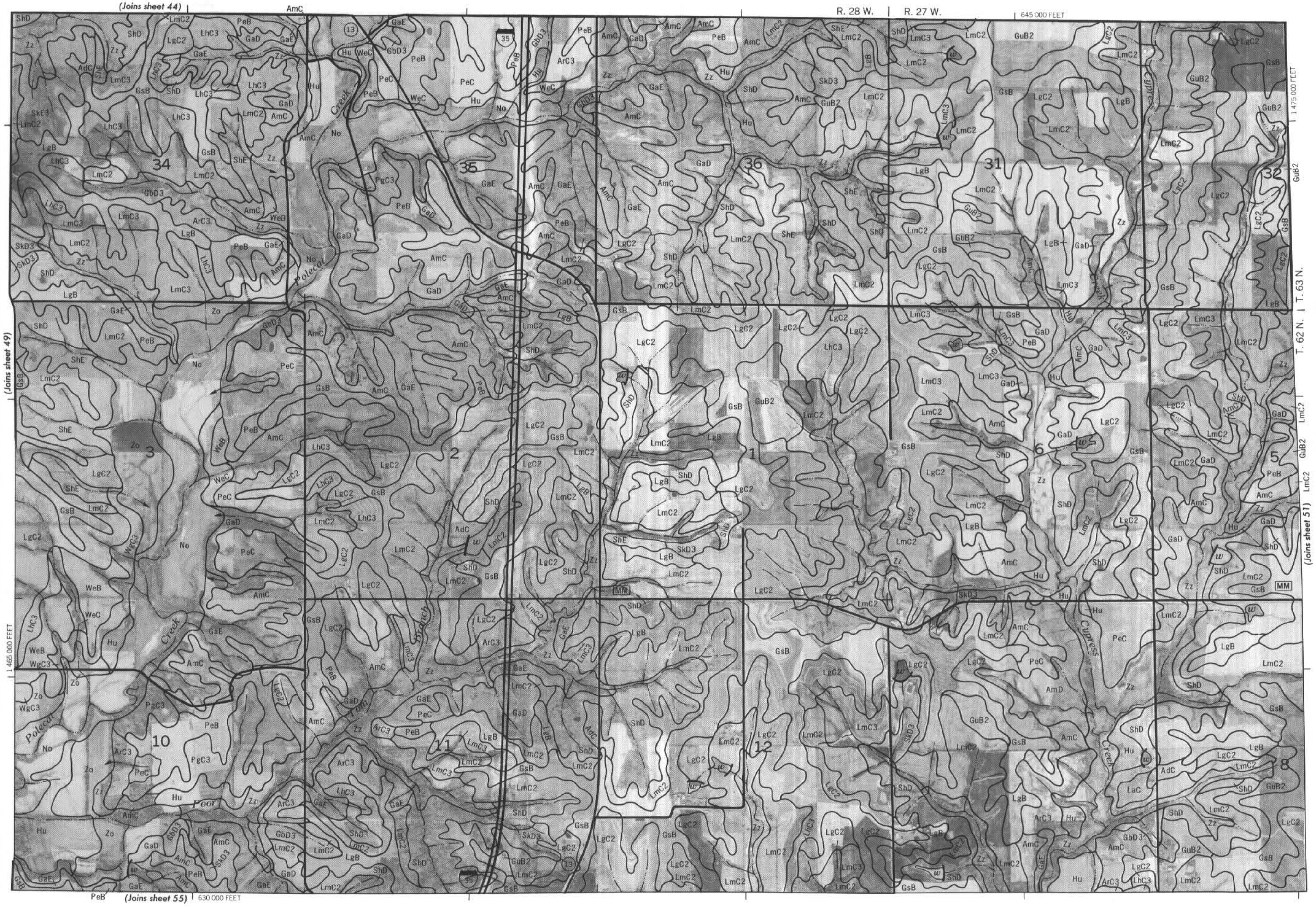
N

1 Mile

5000 Feet

Scale 1:20000

0 1000 2000 3000 4000 5000



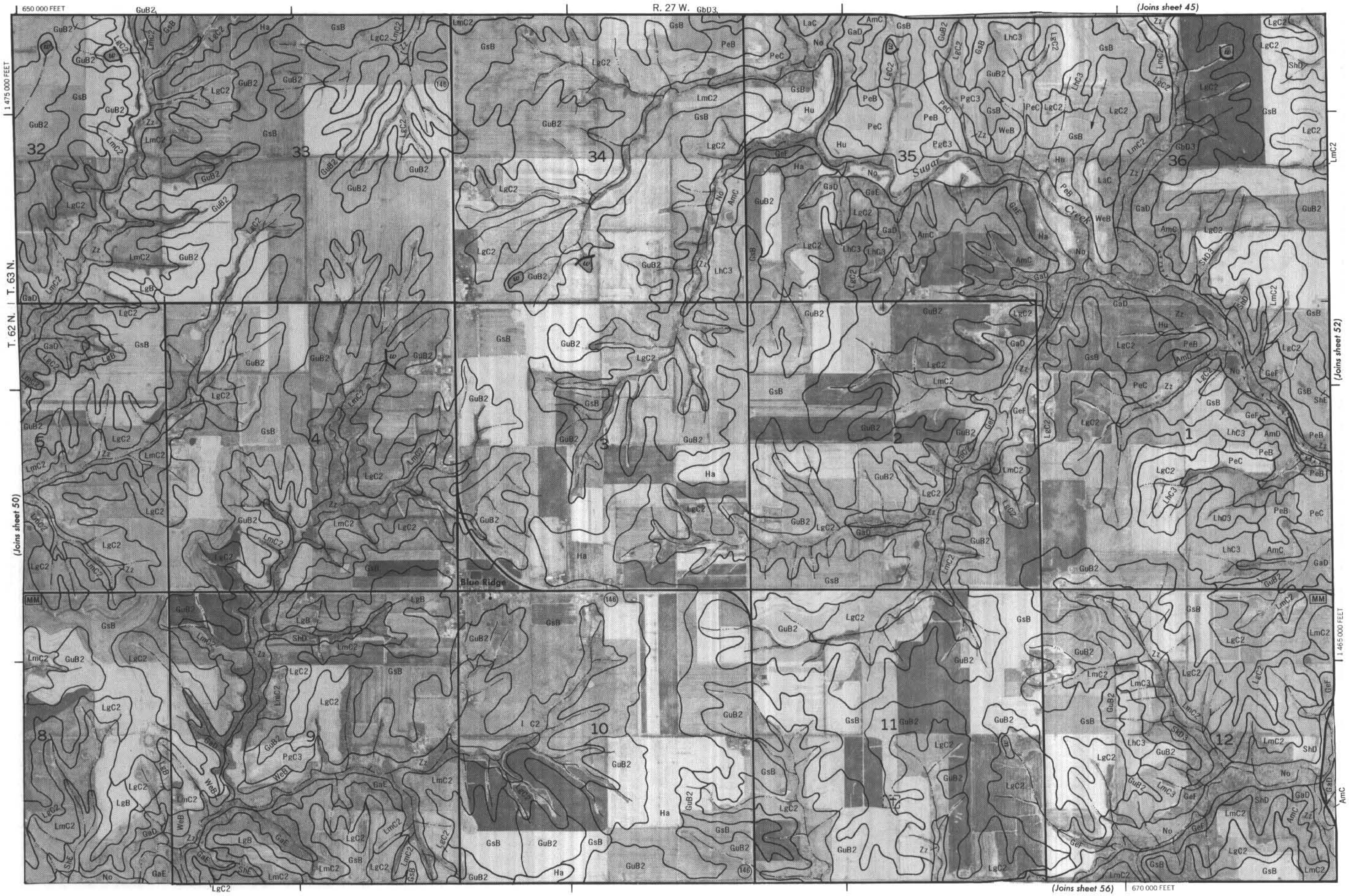
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 50

HARRISON COUNTY, MISSOURI — SHEET NUMBER 51

51

N



Scale 1:20000

1 Mile

5000 Feet

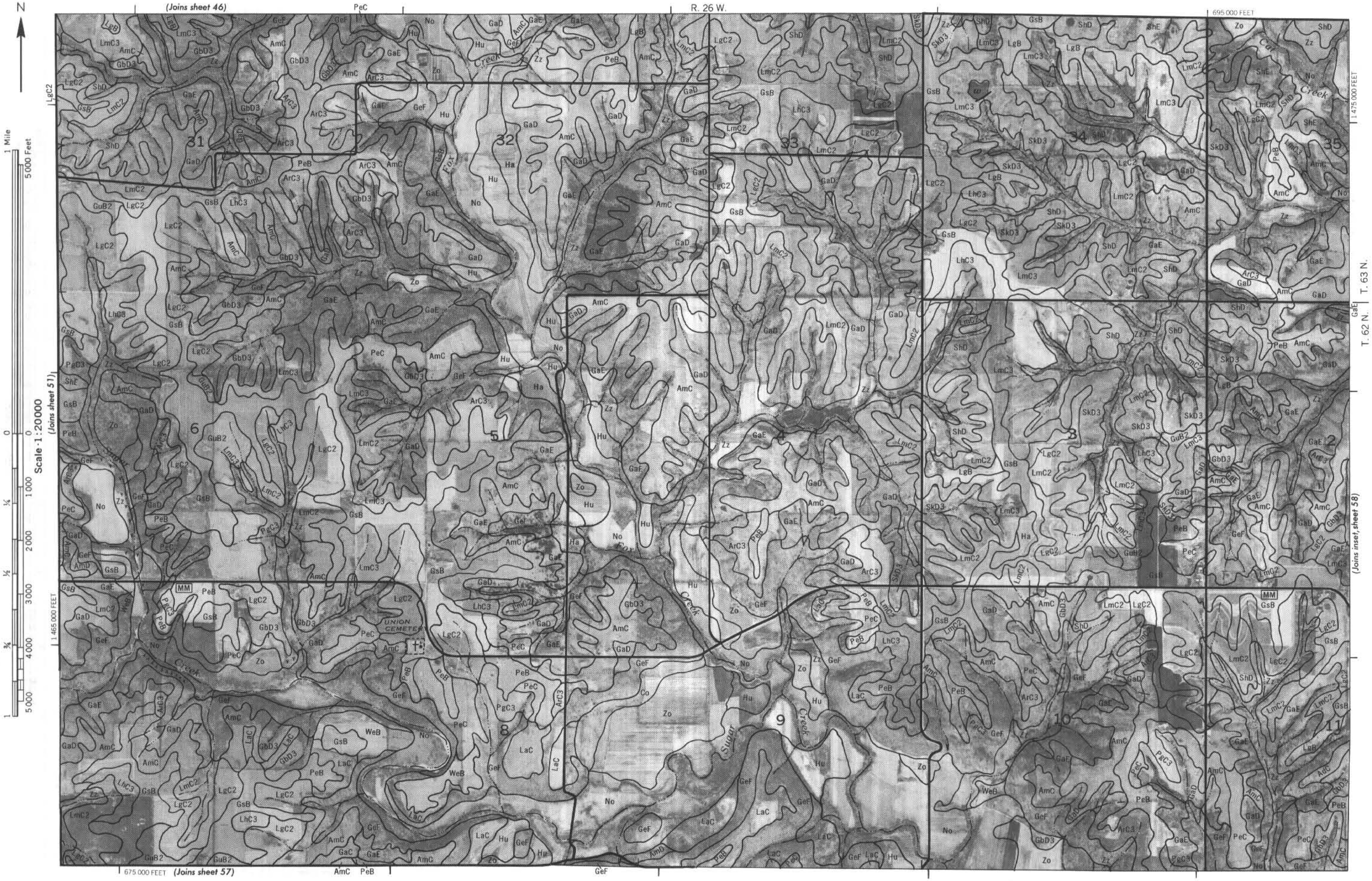
0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

HARRISON COUNTY, MISSOURI NO. 51

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

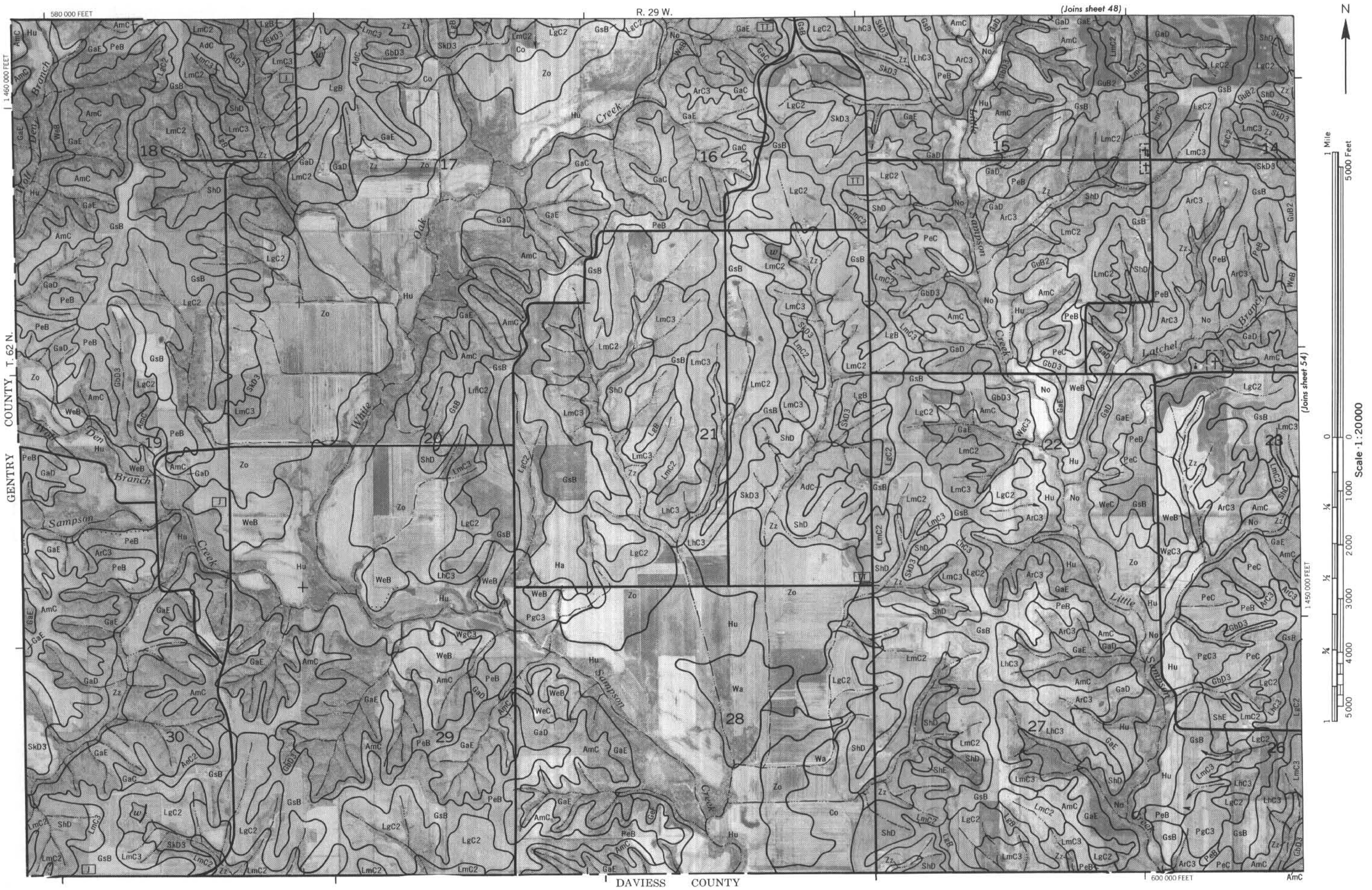
HARRISON COUNTY, MISSOURI — SHEET NUMBER 52



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

HARRISON COUNTY, MISSOURI NO. 52

HARRISON COUNTY, MISSOURI — SHEET NUMBER 53



HARRISON COUNTY, MISSOURI NO. 53

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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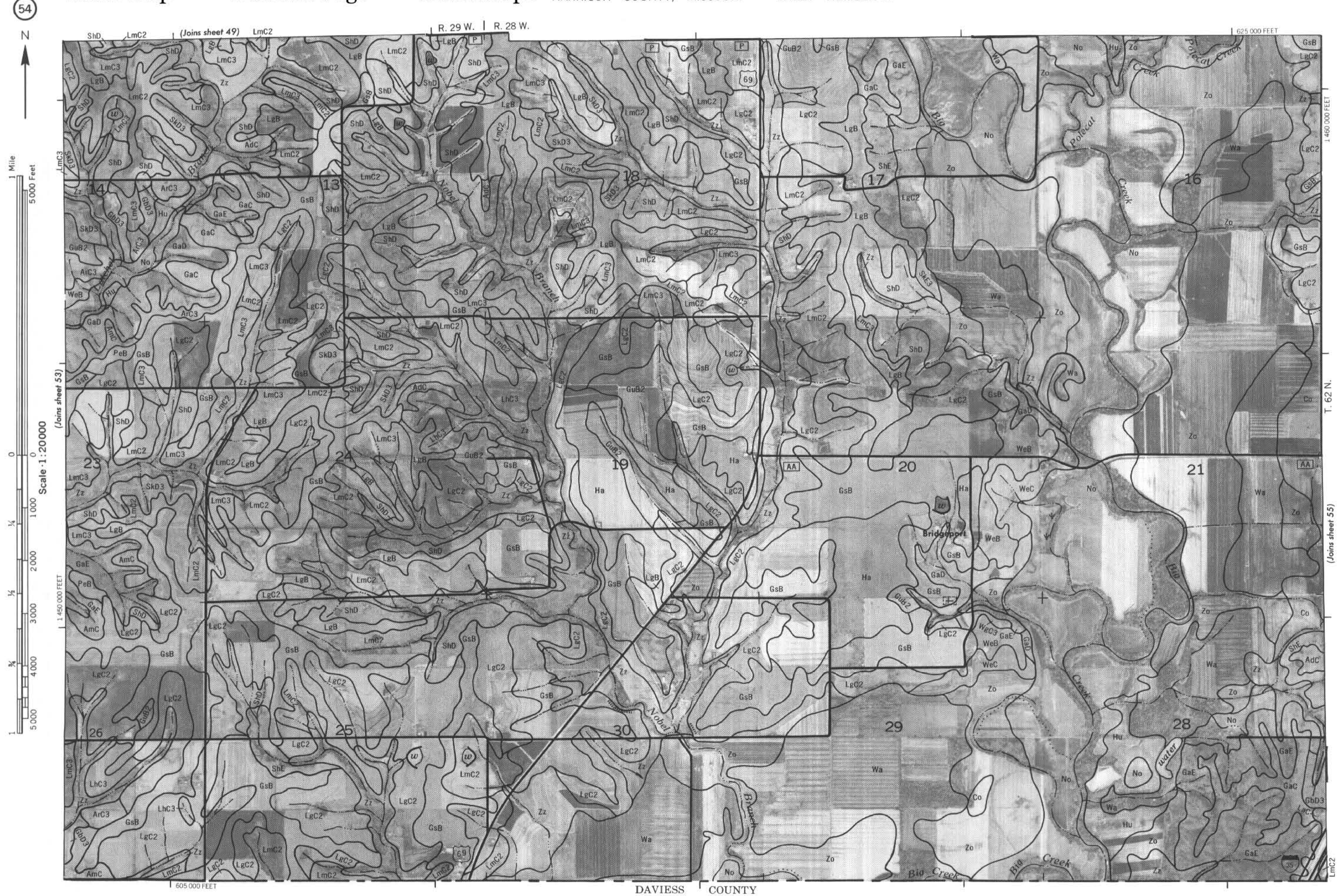
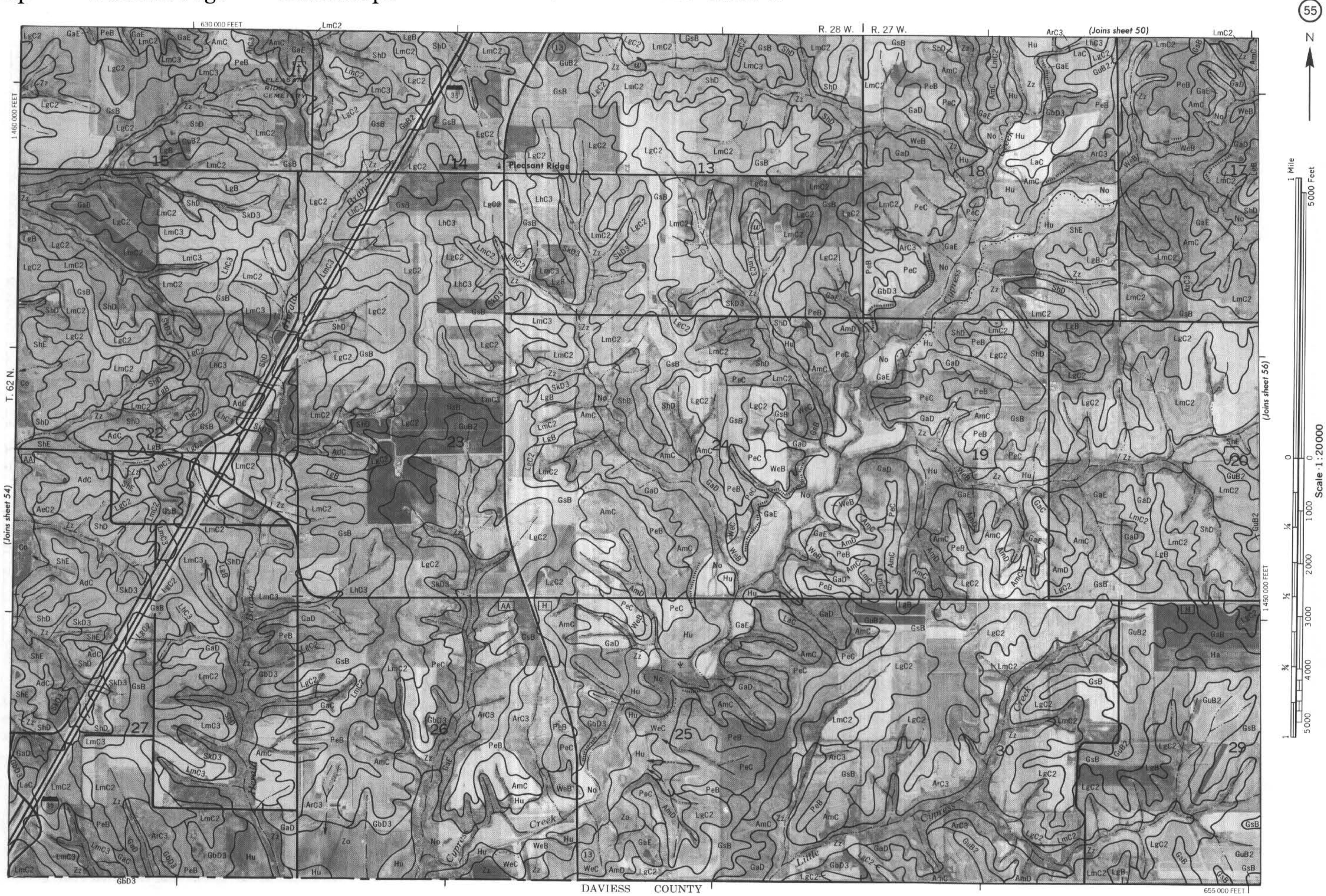


This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

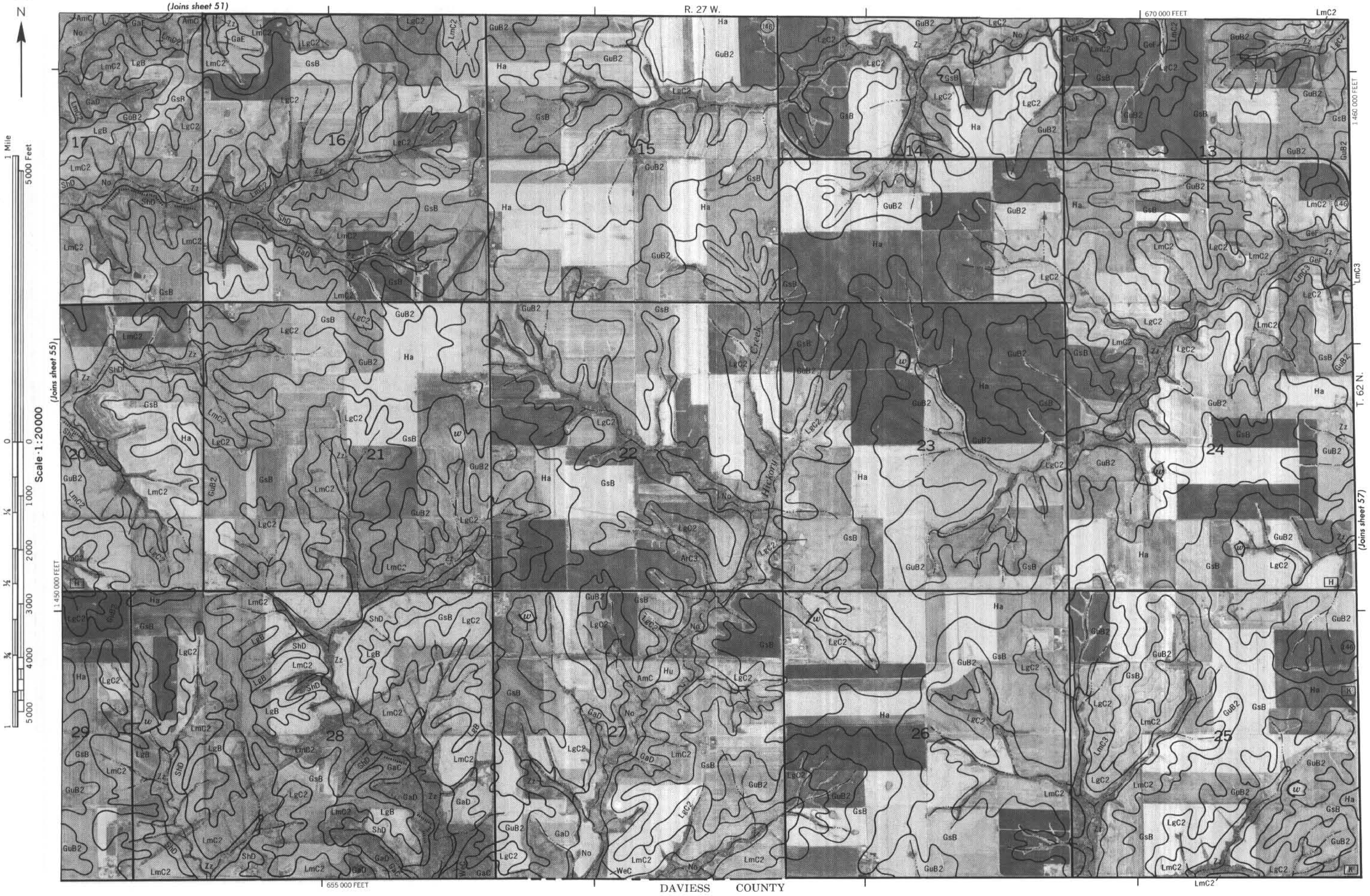
HARRISON COUNTY, MISSOURI NO. 54

HARRISON COUNTY, MISSOURI — SHEET NUMBER 55



HARRISON COUNTY, MISSOURI NO. 55

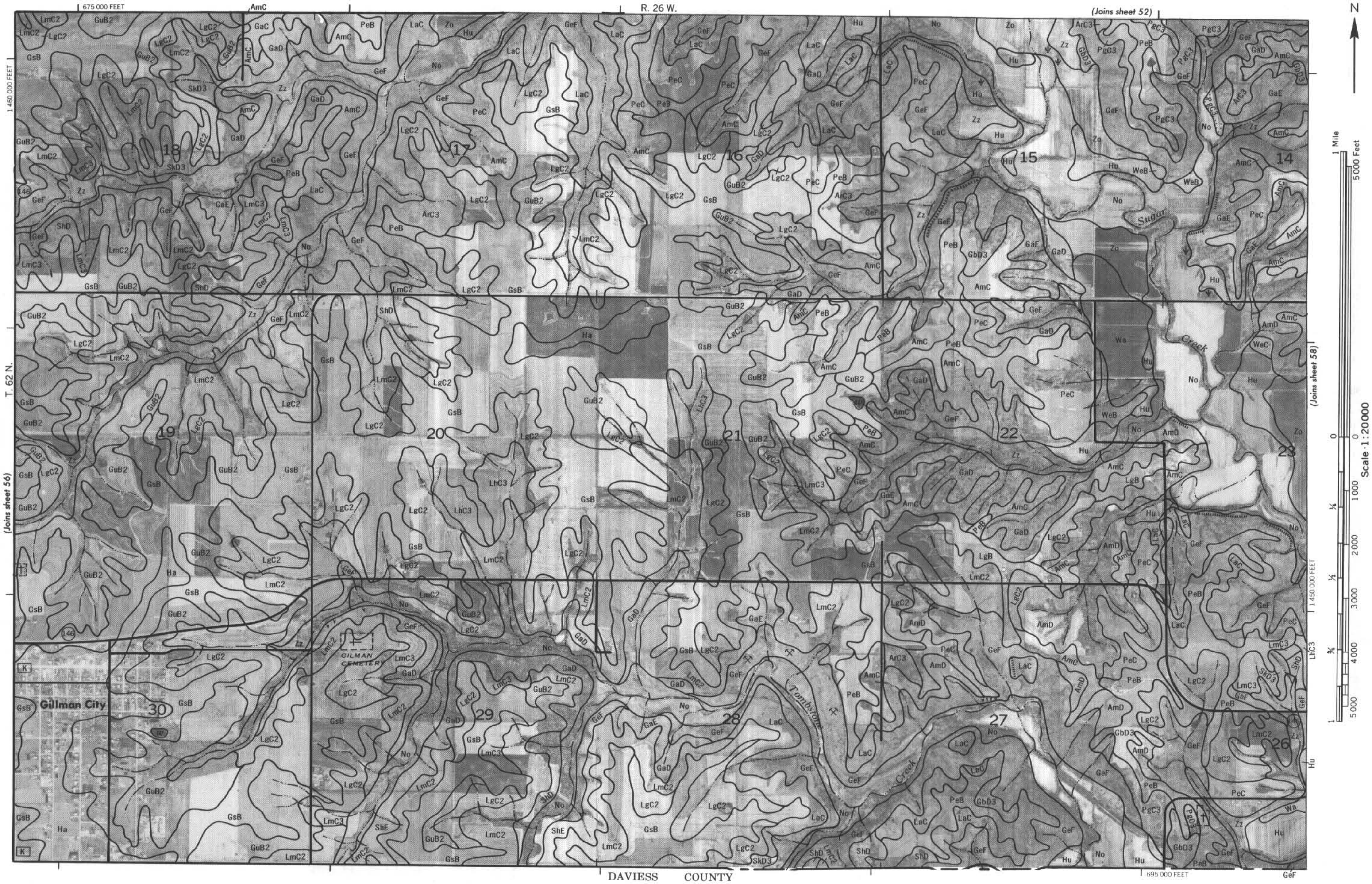
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

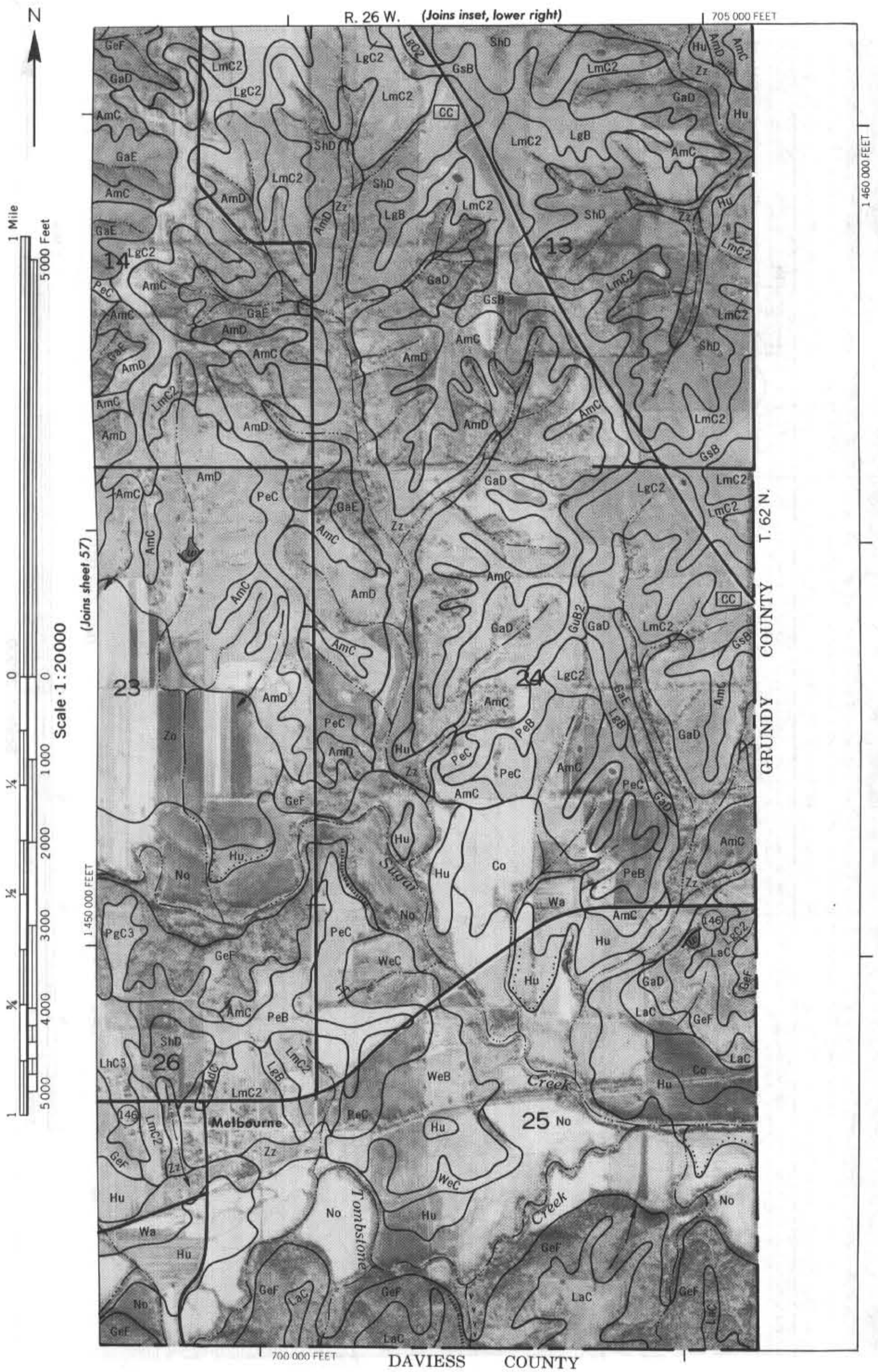
HARRISON COUNTY, MISSOURI NO. 56

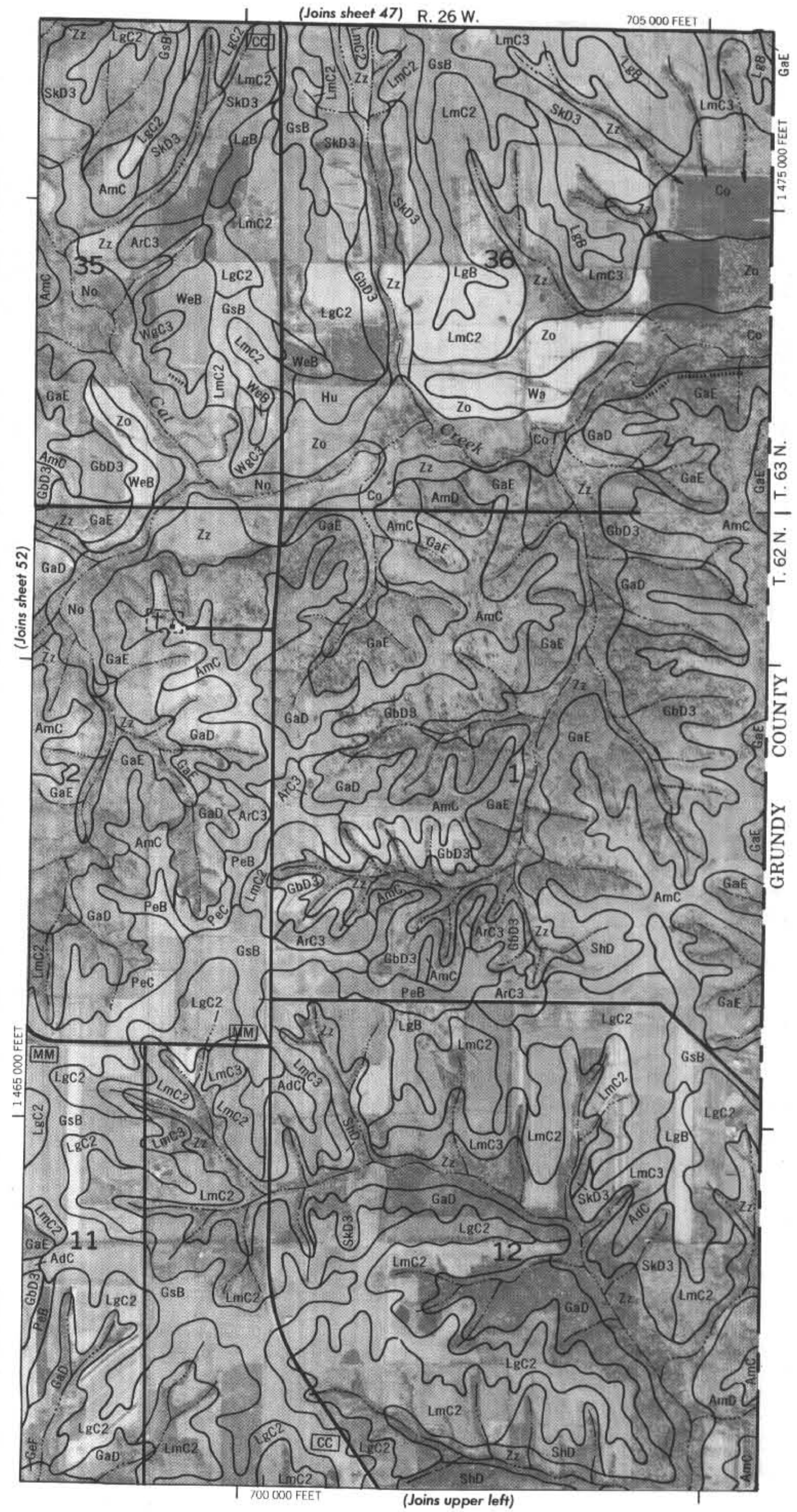
HARRISON COUNTY, MISSOURI — SHEET NUMBER 57



HARRISON COUNTY, MISSOURI NO. 57

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.